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THE ASSOCIATION was organized in Boston, Mass., on June 21, 1882, with the object of providing its members with means of social intercourse and for the exchange of knowledge pertaining to the construction and management of water works. From an original membership of only TWENTY-SEVEN, its growth has prospered until now it includes the names of over 700 men. Its membership is divided into two principal classes, viz.: MEMBERS and ASSOCIATES. Members are divided into two classes, viz.: RESIDENT and NON-RESIDENT, — the former comprising those residing within the limits of New England, while the latter class includes those residing elsewhere. The INITIATION fee for the former class is FIVE dollars; for the latter, THREE dollars. The annual dues for both classes of Active membership are THREE dollars. Associate membership is open to firms or agents of firms engaged in dealing in water works supplies. The initiation fee for Associate membership is TEN dollars, and the annual dues FIFTEEN dollars. This Association has six regular meetings each year, all of which, except the annual convention in September, are held at Boston.

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NEW ENGLAND WATER WORKS ASSOCIATION.

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This Association, as a body, is not responsible for the statements or opinions of any of its members.

FORESTRY.

BY L. W. GOODRICH, FORESTER OF HARTFORD WATER DEPARTMENT.

[*Read April 13, 1910.*]

In considering the relation of forestry to water works, it may be well to begin by reviewing the condition of the forests in this part of New England, and the treatment recommended by foresters.

As is well known, the woodland of southern New England is nearly all second growth of sprout origin, most of the original timber having been cut off during the colonial period. As a rule, our forests are cut when forty or fifty years old and supply only material of small dimensions, principally ties, poles, piles, cordwood, and inferior lumber. Although American trees reproduce well by sprouts, the sprouting power of stumps falls off considerably after the trees reach the age of thirty or forty years. For this reason, in Europe sprout growth is cut at that age.

Trees of sprout origin are not as long-lived as seedling trees, consequently they do not reach the height and diameter growth of those from seed and produce a smaller and cheaper grade of lumber. When fifty years old they usually begin to rot at the butt, being infected from the old decaying stump. As virgin timber becomes exhausted in the states which now supply New England with the better grades of lumber, it will be necessary to produce this lumber locally. In order to obtain a higher grade of lumber from our forests, it is necessary in the first place to replace sprout growth as far as possible with seedling trees. One of the best methods which

can be used to accomplish this result is by what are called reproduction thinnings. A heavy thinning is made, taking out 30 to 50 per cent. of the stand. In doing this, defective trees and those of inferior species are removed. This opens up the stand and lets in light sufficient to promote reproduction of the most valuable trees by seedlings. As soon as satisfactory reproduction is assured, the remaining trees are taken out in one or two successive thinnings. Of course, there will be sprouts in the new stand, but there should be a considerable proportion of seedling trees.

Practically all of the woodland of southern New England is of one main type, that is, mixed hardwoods. The character of this type varies according to the quality of the soil on which it grows. On the deep rich soil of lower levels, chestnut, white and black oaks, and hickory predominate, while on the shallow soil of stony ridges, chestnut oak constitutes the bulk of the stand. Usually on poor soil the stand is not dense, and since trees like chestnut oak are useful only as firewood, it does not pay to make any thinnings. On the other hand, the trees on better soils are in a crowded condition and after the stand has reached its main height growth, improvement thinnings are made in order to increase the diameter growth of the most valuable species. When making these thinnings, dead, dying, and suppressed trees are usually all taken out and also those individuals which are interfering with the growth of the most desirable trees. By removing these trees, more light and growing space is given to the crowns of those which remain and the increased growth may shorten the time of maturity from ten to twenty years. The percentage of straight trees for ties and poles will be greater than without this treatment.

The area covered by forests in New England is steadily increasing on account of the many abandoned farms. Usually gray birch and red cedar are the first trees to take possession of these farms. If there are seed trees nearby, white pine seedlings establish themselves under the birches and usually in from ten to fifteen years the pines kill the birches because the latter are very intolerant of shade. In from thirty-five to forty years after it is abandoned, this land will produce from 12 to 15 cords of wood of small value. If, instead of waiting for natural reproduction to take place, these old fields are planted to chestnut or oaks, they would in from

thirty-five to forty years produce from 35 to 40 cords of wood, much of which could be cut for ties. It is probable that 100 piles would be produced on an acre besides about 50 ties and 10 cords of wood. At the present market price for these products this would be a return of over 3.5 per cent. on the investment.

Unless some method of purification of water is in use, water companies usually adopt the policy of acquiring by purchase absolute control of their drainage areas in order to keep off undesirable inhabitants. In carrying out this policy, the Hartford Water Department has purchased 3 300 acres of land, or about one half of the total watershed of the reservoirs. More than 50 per cent. of this area is sprout growth from five to fifty years old and is growing principally firewood. One third of the property is open land, including old fields which are growing up to birches, cedars, and other scattering trees.

In 1902 Prof. Henry S. Graves made a forest map of the tract and a plan for its management. The map shows in color the age of the compartments and in the plan a treatment is recommended for each portion according to its character, age, and condition. The carrying out of this plan will put the woodland in better condition and will also utilize the open land by planting it up as rapidly as practicable. Growing cordwood is profitable only when near a market, in fact, it should be only a by-product in good forest management. Our plan is to grow trees large enough for poles and lumber. Nearly all the thinnings thus far have been made in stands forty to fifty years old in which heavy cutting was done in order to procure some reproduction by seedlings. One thousand and sixty-two cords of firewood have been taken out in thinnings on 92 acres. Some of the wood was sold at a profit of 60 to 85 cents per cord over the cost of cutting.

The Hartford Water Department owns a lot of land which is being held solely for the protection of the supply from pollution. A large part of this land can be used in no way except for growing trees. This applies to the open land, some of which has a scattered growth of poor trees. Since 1903, 175 acres of this land has been planted up, using 125 000 white pine, 76 000 white ash, 20 000 hard maple, and other seedlings. In addition to this, we have planted directly, seed of chestnut, white and red oaks, and hickories.

In most cases the planting has been to pine in mixture with the other species; the permanent plantation is to be of nearly pure pine. One reason for planting in mixture is that it is cheaper; furthermore, pine grows clearer with a few hardwoods to help prune its lower branches. All but the choicest of the hardwoods will be taken out in thinnings. The indications are that the pine will outgrow most of the trees in the mixture except possibly white ash and red oak.

In preparation for planting, furrows are plowed 5 feet apart and the trees are then planted 6 feet apart in the rows, or about 1 500 trees to the acre. The trees planted in 1903 now average over 6 feet in height and are growing at a rate of about 2 feet a year. In most places the indications are that the planting will be very successful. An average of 90 per cent. of the pines are living. The cost of planting is greatly reduced by establishing a nursery and growing seedlings instead of buying them of nurserymen. Not only is the cost less, but the trees are in better condition when planted, since the seedlings are moved from the nursery directly to the field and the roots do not become dried out, as they often do when shipped. We have about one third of an acre in nursery and this spring there were 160 000 white pines and about 15 000 maple in the beds.

There is no difficulty in growing hardwood seedlings. In growing pines and other coniferous trees, more careful attention is required. The seed beds are rolled after seeding and covered with leaves or straw to prevent their drying out. Sunlight is not essential for seed germination, but when the seedlings break the ground, light is required. The beds must be carefully watched and as soon as the leaves appear above the ground the protective covering should be removed. If this is not done within two or three days the young seedlings will probably die. In one other respect conifer seedlings require special attention, that is, keeping the beds well watered during the first three months after germination. This is necessary because of the shallow root system of coniferous trees. There is no tap root as is common with hardwoods. A covering of screens which provide half shade is usually placed over the beds during the hot months to hold the moisture and inure the seedlings to shade when planted among larger trees. (See Plate I.)

FIG. 1.

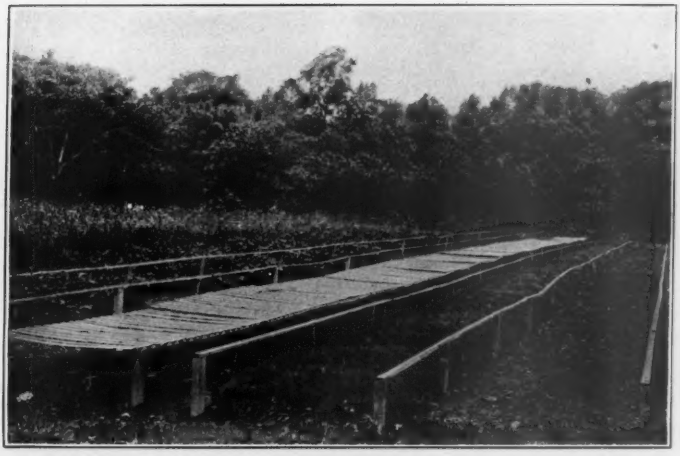


FIG. 2.

NURSERY AT WEST HARTFORD.

If larger trees are desired for planting, the seedlings are transplanted in rows in the nursery and allowed to grow a year or two before being planted permanently. Much stockier trees are obtained in this manner, but when a large number of trees are being planted it is better in most cases to use one-year stock. When the trees are to be planted in tall grass, or where shaded by older trees, it is advisable to use transplants.

Considering the difference in cost of transplants and seedlings bought of nurserymen, it is more economical to purchase seedlings. The high cost of seedlings has been one of the difficulties in the way of forest planting, but the larger numbers now being grown in the state nurseries and sold at cost has reduced the price to about $3 per thousand.

Mr. Mulford, a former state forester of Connecticut, made the working plan for the Higby Mountain Reservoir tract under the control of the water commissioners of the city of Middletown. The plan called for the planting of 168 acres. Work was begun in 1903 and up to the present time about 59 acres have been planted with 125 000 trees. Extensive planting was to be done, using pine in mixture with hard maple in alternate rows. The pines were planted and are doing well, but the maples have not been put in. The result is that the pines are too far apart on these areas to form a good stand and have so much start that unless interplanted by very rapid-growing trees they would entirely suppress them. The only species that could be safely planted between these rows is Scotch pine, which is rapid growing and tolerant enough to withstand crowding of the older white pine. White pine three-year-old transplants were used in this planting and 95 per cent. are alive.

At Middletown the planting of chestnut and oaks has been very successful, when transplants from the nurseries were used, but it has failed where seed was planted directly. Many experiments with various species and mixtures have been tried, but the results thus far seem to indicate that white pine is the best tree to plant.

The New Haven Water Company has made a coöperative arrangement with the Yale Forest School under which the land about the Maltby Reservoirs is available to the school for work of experimentation, and the school in its turn takes charge of all forestry work on the tract.

In consequence of this arrangement, a number of experiments have been undertaken. The financial results have been favorable because a good deal of the planting has been done by students for practice. Considerable underplanting with evergreen trees has been done near one lake in order to replace the present hardwood stand with a mixed coniferous and hardwood forest. The open land is being planted up as fast as the school can undertake the work. Up to the present time 100 acres have been planted.

The Ansonia Water Company has done considerable planting, largely to white pine. This company has secured instructive results in practical forestry, especially in handling chestnut ties and poles.

All of the water companies have waste land, which is producing scarcely anything. If it can be shown that the returns will pay a fair rate of interest on the cost of planting up this land, the investment should present itself as a good business proposition for water works. Of course, it is impossible to predict the future value of pine lumber, but probably prices will rise as the old timber becomes more scarce.

It costs $7 to plant an acre with two-year-old pine seedlings. In fifty years this pine should yield at least 30 000 board feet per acre at $6 per thousand, as box-board lumber. Allowing $3 per acre for thinning, at the end of fifteen years and 25 cents per year for taxes, the investment would net 4 per cent. compound interest at the end of fifty years. This calculation is made on a land value of $12 per acre. Measurements made in a natural grove of white pine at Windsor, Conn., show an average yield of 35 000 board feet per acre. If this grove had been thinned systematically, it is probable that the yield would have been much greater.

It is noticeable that white pine is the tree preferred for planting throughout the state. This preference is largely on account of its value for lumber. It grows rapidly and is suitable for planting on almost any kind of soil, even on sandy soils where most other species would prove a failure.

The prevalence of forest fires is the greatest hindrance to the practice of forestry. In fact, unless some protection is provided against fires, planting of coniferous trees cannot be recommended.

Protection can be secured by patrolling the forest during the

FIG. 1.
FOREST BEFORE THINNING.

FIG. 2.
FOREST AFTER THINNING.

dry times in the spring and fall. The patrol system is expensive and will not pay on a tract of less than 1 000 acres. A fire can be limited to a few acres by means of fire lines. It is evident that these lines must be kept free from grass, leaves, etc., in order to be of use in stopping a fire.

In recent years there have been no serious fires on the Hartford watershed. This may be due in part to good fortune, but careful lookout is kept by watchmen, whose duty it is to patrol the watershed for other protective purposes, and by other employees of the department. Forest fire laws are continually made more rigid and penalties greater, but much can be done to prevent fires by creating a change of public sentiment against carelessness in kindling fires.

Because not much wood is destroyed, most people underestimate the damage done by ground fires. Not only is the leaf litter burned, the soil impoverished, and the growth of the trees checked, but usually all seedlings are killed and the larger trees become infected with disease and decay, on account of the scorching of their bark.

The state of Connecticut has a very efficient forest fire warden service which is greatly diminishing the damage done by forest fires. The new law, requiring all persons to obtain written permission from the district fire warden to kindle fires, is a move in the right direction and time will prove its efficiency, but it certainly has increased the duties of the town fire wardens. The work of the state through the agency of the state forester and State Agricultural Experiment Station has been very effectual in arousing interest in forestry throughout the state.

The state owns over 1 500 acres of brush, forest, and pasture land in Simsbury, Portland, and Union. On this land planting and thinning has been done, not only to improve the land, but to show the people of the state what can be done by the practice of forestry. This demonstration has had a marked influence in the towns where these forests are located, and the adjoining towns in stimulating a desire to plant forests and improve woodland. It was estimated by Mr. Hawes last year that nearly one hundred owners in the state were practicing forestry. I think at least a million and a half trees have been planted. This planting by business men and farmers indicates that forestry appeals to them as a good business proposition.

The importance of forestry is becoming more generally recognized in this country as the supply of virgin timber approaches exhaustion and prices of the better grades of lumber rise in consequence. The length of time required to produce the best grades of lumber will, in the near future, restrict the source almost wholly to national and state forests, since private owners prefer to cut their forests at short intervals in order to get returns on their investment although inferior lumber only is obtained.

Our national forests contain 194 000 000 acres and the state forests nearly 3 000 000, yet three fourths of the forest land of the country is privately owned. The first consideration of private owners is profit. If forestry is not good business they will not adopt forestry methods. It is true that in this country forestry has been practiced only a few years, and no conclusive results have been reached, but in European countries forestry methods employed for many years have proved a financial success. For example, in Prussia the net returns per acre are nearly ten times what they were sixty years ago, and they are increasing more rapidly than ever. Probably the best example of forest treatment is in Zurich, Switzerland. This city's famous forest has been managed under a working plan since 1680, and is to-day one of the most perfectly managed and most profitable forests in the world. It yields on an average a clear annual profit of $12 per acre.

Different conditions in this country require different methods in applying forestry, but it is safe to assume that the results will be equally successful. European countries, which are now far advanced in the practice of systematic forestry, have passed through the same stages in relation to forests as our own country. In fact, in the case of nearly all countries, the danger of famine in lumber has been the principal cause of the adoption of forestry. It is estimated that we are cutting annually three and one half times what our forests yield. At this rate of consumption, it is evident that the present supply of lumber will not last many years.

By a conservative use of our present forest land and by utilizing all waste land by planting, it is believed that the yield can, in time, be made equal to the demand.

DISCUSSION.

R. C. Hawley, Esq.* I think you would perhaps be most interested, gentlemen, in learning how forestry can be of use to you, — what sort of a business proposition forestry is for a water company. Water companies are in a good deal better shape to practice forestry than the average person, or the average company, because the water company usually has around its reservoir considerable land which they must hold. In the case of some companies, they own the entire watersheds which surround their reservoirs. This land falls in two classes: First, a large part of it is land which is absolutely worthless for anything but the production of timber; and, second, land which was at one time cultivated and capable of producing farm crops, but which you gentlemen are becoming more and more convinced should not be used for crops around your reservoirs. Frequently, you are taking down the farmhouses and ceasing to cultivate the land. Water companies, therefore, are in the position of owning land which they can use in no possible way except for growing timber. You cannot get any money out of that land, except by producing wood crops; so, if you want to get a profit from your land, as well as from your water, you must fall back on the growing of trees.

Forestry is a long-time investment. It calls for considerable waiting, in our country, before the returns come in. Water companies have an indefinite existence, and ordinarily they have more means for long-time investments than private individuals have. Such companies are well able to make the investment which a businesslike forestry demands.

Forestry work also affords an opportunity for a water company to use steadily their skilled labor, which in certain seasons of the year is employed in the construction and maintenance of their pipe lines, — by keeping those men whom they want to retain employed in the winter time at work in the woods. How far that applies to all of you, I don't know; I know that it does apply to some companies. They are glad to have the opportunity of putting the pipe gang into the woods in the winter and covering the expense of that gang.

There is another way in which forestry should appeal to water

* Professor of Forestry, Yale University.

companies, and that is in the line of a protecting cover to their sheds. That, of course, is an indirect benefit, — the protection which a forest affords around reservoirs, especially near roads, against the blowing in of dust from these roads, or, where there is a steeply sloping country, against the washing of silt and debris of all sorts into the reservoir. As a protective agency alone, it would often be advisable to maintain forests on these sheds.

Now in practicing forestry, what return can a water company hope to secure? Mr. Goodrich has spoken of the profits which come from a well-managed forest. These profits may range from one dollar to twenty dollars an acre net per year, on land devoted to forestry. That is something which would be secured from land which otherwise lies vacant, idle, and does not bring you in any return. But in starting forestry work I want to caution you that such returns cannot be obtained right off, unless your land is now stocked with considerable merchantable timber. Financial returns in forestry come only after your tract has been put in proper shape. A great deal of your land, undoubtedly, is sprout land, small, young woods or bare fields, and you can no more expect to get an annual return from that land now than you could expect to go out and buy an abandoned farm and make it pay you profits until it had been brought up by fertilization and proper methods of cultivation. So, in starting forestry work, the chances are that every one of you would have to anticipate deferring your profits for a period of possibly ten or twenty years, when you might expect to begin to secure small annual returns from your land.

I do not believe, however, that there is a company represented here, possessing either vacant land or forest land, which could not, by starting forestry work, assure itself of an income ranging from a few dollars to a good many dollars per acre per year in the long run from these lands; and I repeat that inasmuch as those lands are mainly lying idle, it is a good thing to take up forestry work and get an income from land which would be otherwise unproductive.

THE PRESIDENT. We have with us a gentleman who, I understand, has had considerable experience in the practical work of forestry. I have the pleasure to present Mr. E. B. Bronson, of Winsted, Conn.

ELLIOT B. BRONSON, ESQ. *Mr. President and Gentlemen of the New England Water Works Association,* — I suppose I am asked to come here to tell you something about getting a financial return out of your by-products. I am not a water-works man, I am not a trained forester, but I am a lumberman. I agree with Professor Hawley that the investment is a long one, and yet from an experience of twenty-five years I think I may tell you that it is generally a successful one. I am not going into some of the details I expected to, owing to the lateness of the hour, but I will give you just a few concrete illustrations that I worked out from my own experience.

To show you what you can get from pine lumber land in Connecticut and Massachusetts, I will say that, a short time ago, I cut a piece of 23 acres. This was heavy pine timber which had been well cared for. I cut off 957 000 feet of lumber and 617 cords of wood from the 23 acres. There were 730 pine-trees on that piece that cut 750 000 feet of lumber. That was an exceptional piece for New England, but it was because it has been cared for by good forestry methods and was a valuable investment for the owner, and also for me.

Now, speaking of our sprout land, Litchfield County, which is the largest county in the state, contains 612 600 acres, or more, and 55 per cent. of it is sprout and woodland. Only an insignificant portion of this can be estimated as virgin forests. The forest area can be subdivided into the mixed hardwood type and common hardwoods, including chestnut, of which species there is about sixty per cent., covering about 264 000 acres, or about eighty per cent. of our forest land; the white pine type of 3 600 acres, or about 1 per cent.; and the abandoned field type, which consists of our old back pastures and abandoned farms, that, uncared for, are growing up to white birch, alder, scrub pine, poplar and hemlock, of about 70 000 acres, or about nineteen per cent.

The age in years of the hardwood type is estimated as follows:

71 800 acres, 1 to 20 years;
180 000 acres, 21 to 40 years;
9 000 acres, 41 to 60 years; and
3 200 acres, 61 years and upwards.

It is estimated that of this there are about 242 000 000 feet of chestnut and oak lumber; 80 000 000 feet of other kinds of lumber, leaving a balance of 4 300 000 cords of cord wood, with a grand total value for our forest tract of $4 512 000, or an average of $13.40 per acre for the average forest crop of Litchfield County. We, are, however, cutting this wood off so fast at the present time that in about twenty-three years, unless we do something to replenish it, it is all going to be gone. New Haven County is in a still worse condition than that. I might give you something in detail in regard to the figures, but I will not stop for that. The point I was making is that our mountain countries are your sources of water supply and they must be cared for; and, if the forests are denuded, you gentlemen, of course, know what effect it will have on your water supplies.

Now, speaking of the long-time growth of sprout land, I have a record of twenty-five years of experience of all the lumber we have cut in that time, giving the number of feet of each kind of lumber produced, cords of wood, poles and posts, and the cost of production, all tabulated, which is a valuable thing to me in my business. I took off a concrete illustration, which I thought was a fair one, of a mountain side which is on the watershed of one of our Litchfield County water supplies. My father bought the land, 43 acres, forty-five years ago, as an investment, as he said, for his children. It had all been completely cut off, — just skinned, as we say. He paid $135 for it. His children, or I, one of them, cut it off after forty-five years' growth. I cut 155 654 feet of lumber, 1 550 cords of wood, $250 worth of piles and posts, giving me a gross profit of $2 284.84. On the original cost, $135, I figured six per cent. against it for forty-five years, or $364.50; I figured the taxes for forty-five years at $202.25; then I charged $500 for my services in marketing the product, and I had left $1 118.09, or a total net profit of 855 per cent, or yearly net profit of 19 per cent., plus the 6 per cent. which I had charged on account of the original investment. That wasn't forested, that wasn't cared for, that was simply as nature gave it to us.

I have been practicing forestry for some few years, setting out trees with the rest of you. I think there were some 600 000 trees set in the year 1908 in Connecticut, and more set in 1909. I think

some 2 500 acres were set in New England by private parties up to 1908, and the amount was much increased in 1909.

I am convinced, gentlemen, that as a financial proposition, as a by-product of your water works, there is nothing that you can do, primarily to protect your watersheds but also as a financial investment, which will bring you better returns than planting trees, preferably in this section pine or chestnut, because they are the quicker growing and the more ready to help nature out.

Mr. William F. Sullivan.* The reason why I came here to-day was, that I was desirous of acquiring some information with regard to forestry. We have about 800 acres in our reservation, of which about one-fifth is water. The rest may be classified as woods, pasture, forest, sprout land, and cultivated land. While improving, thinning, and developing, the question arises how to handle the ripe or financially mature trees and the thinnings.

I have been much interested in the remarks of Professor Hawley, and especially in those of Mr. Bronson. From the latter's remarks and the knowledge he possesses regarding lumbering, I judge he will be able to show us what to do and how to do it.

Now, we are not particularly impressed with the idea of planting white pine unless natural reproduction is almost impracticable. We believe in natural reforestation, that is, by the strip method of cutting, or leaving from three to six veteran seeders to an acre. There are timber lot operators in New Hampshire — and one large operator in particular, with whom I am somewhat familiar, who has cut probably as much as any other man in the state. He, like the others, has generally bought the land and stumpage and has never practiced modern methods. He has never safeguarded his own interests by permitting any seed trees to be left on a cut-over territory, but has always slaughtered the forests by cutting off every tree. Well-informed people and authorities in forestry and the lumber business say that if this man had left a few seed trees per acre on the vast tracts which he has cut over, the present value of this land, which is now a barren waste or covered with a worthless growth of scrub oak, would be more to-day than the gross receipts from all of his lumbering operations.

In regard to the kind of wood, we believe that white pine will be

* Engineer and Superintendent, Pennichuck Water Works, Nashua, N. H.

the most profitable. We are cutting off the hard woods. We find in many instances oaks which show from seventy to eighty years' growth from stem analysis, to be about six inches in diameter. Their growth is too slow. Then again, the browntail moths have invaded our forests, and the cost of extermination without cutting is prohibitive. Some of our pine timber land will cut from 21 000 to 57 000 board feet per acre. We have at the present time about 2 000 000 feet on the stump, and, according to our survey, we ought to thin out about 300 000 feet. Of course as a water works we are interested primarily in the forest cover. That was the original object in acquiring these forests. But now we feel as if the time has arrived not only to reproduce and develop the white pine forests but to study the financial status of our forests.

When we take it up as a money producer, how are we going to handle the product to the very best advantage, with the factors usually to be found in a water works, such as men and mechanics available at times, undeveloped water power, and an organization that will not add much if any expense to the supervision and selling?

If we employ a portable sawmill outfit, at a low cost per thousand, they will want to cut ruthlessly and slaughter the wood lot, for they are simply working at top speed for the little profits there are in it. If we can utilize our seasoned men to an advantage at such time when they are unemployed, — for we believe we can do as Professor Hawley says,— we can do the work more carefully and with less injury to the pine undergrowth. When the thinning is completed, even if the cost is a little more per thousand, the difference in cost is more than offset by the increased value of the remaining immature trees on the cut-over area.

Speaking of the factor of men in a water-works outfit, we all know that it is important to keep faithful, intelligent, and able workmen employed during as many months of the year as possible. One cannot expect to call upon men that were laid off in November and get a free response on a cold night in January, when there is a bad break or a difficult job in a cold, wet, and nasty place.

The particular problem we are endeavoring to solve, while not of the greatest import, nevertheless requires some study and practical information. Is it advisable to put in a portable steam

FIG. 1.

FIRST STAGE, WHITE PINE IMPROVEMENT. NOTE THE FIRE HAZARD.

FIG. 2.

SECOND STAGE, WHITE PINE IMPROVEMENT. BURNING THE BRUSH.
FORESTS OF THE PENNICHUCK WATER WORKS, NASHUA, N. H.

mill, a stationary steam mill, or, as we have an undeveloped water power which requires only the installation of a short length of penstock and a water wheel, shall we put in a water-power mill, the total cost of such an installation not to exceed $3 000?

Our first valuation surveys show that we have at the present time 300 000 feet of trimmings to cut, which cut will improve the remaining trees; that the natural increase in growth at the present time is 60 000 feet annually, and will increase from year to year. Now, I ask you, gentlemen of the Association and the lumber men present, can we advantageously put in a $3 000 water-power mill on the hitherto undeveloped water power?

That brings up the point of the former condition of things in our locality, and, I might say, throughout New England. Not so many years ago, every village and town had its gristmill which ground the corn of the miller and his neighbors, and a sawmill to which they could bring their logs and have them cut into boards or dimension stock, paying in cash or leaving a portion of their haul in payment. They could do it then, when corn and timber were cheap. The West and Northwest could afford to sell and ship the meal in competition, and did so. Times have changed — high prices everywhere. Freight rates have come to be a question which almost every farmer is able to understand and discuss. With the prevailing high prices, why cannot the large and small farmer and land owner come back to his own? I ask where have the mills gone to? Abandoned! We ourselves have been guilty of dismantling at least three such mills and throwing the machinery to the junk pile, allowing the water to pass over the dams without turning a wheel. I believe that "history is going to repeat itself," that the New Englanders will see the light, and that most of us are being educated to the idea that we can grind our own corn and saw our own timbers and get the highest price without too many middlemen's profits.

One of the items of profit which is unusually consumed in steam mills is the slabs. Every 3 000 to 5 000 board feet cut will yield about one cord of slabs, and slabs are worth in our part of the country $2.50 per cord on the cars. Here is a by-product which can be saved by a water-power mill. Water-power mills also eliminate the fire hazard to a very large extent.

I am somewhat concerned to get the benefit of the experience of you water-works men and our friends the conservationists and the lumber men present to-day. I want to find out if it will pay us to put in a water-power mill and go back, as it were, to the prosperous old times, take in such of our neighbors who have jags of timber to be cut into boards or stock, we doing it at a reasonable price, and get the slabs in part payment. Who has not seen the blighted territory with its mound of sawdust after the march of the portable mill, the forest devastated and slashed, the undergrowth largely destroyed?

In the past, farmers and landowners, burdened with mortgages, would sell the stumpage to some operator, and would not realize even a fair price. If he sold his logs, they were scaled by any of forty different log rules for board feet, such as New Hampshire, Scribner, Doyle, etc. Many of these rules, according to the Bureau of Forestry, " are admitted to be inaccurate and unfair by their users, who continue to employ them because a satisfactory rule is not known or is not readily available." " Satisfactory log rules are difficult to construct because the sawed product of logs depends upon the skill of the sawyers and on the kind of machinery used." So you see, gentlemen, the fellow who sells the logs without knowing the rule has been sort of " trimmed," to put it mildly.

Now, when the fellow who owns the logs brings them to the adjacent mill, and dickers for terms, after allowing for the kind of machinery and saw, he gets his logs into boards which have a standard of measurement as sure and positive as the United States standard of weights and measures, also a market country-wide, which makes him independent of a purely local market and enables him to realize much more.

To hark back again, my point is this: Will it pay us to put in a stationary mill, and to cut with our own outfit the 300 .000 feet of already ripe timber? If we do this, we can periodically thereafter cut the annual yield, which is at present 60 000 feet, and will increase yearly, and cut the logs our neighbors may bring. I am trying to find out if it will pay, and I believe that Mr. Bronson who has had such a large experience as an owner and operator, is the one who is going to enlighten me on this, to us, very important matter.

FIG. 1.
THIRD STAGE, WHITE PINE IMPROVEMENT.
"WOODMAN, SPARE THESE TREES."

FIG. 2.
FOURTH STAGE, WHITE PINE IMPROVEMENT.
WOODMAN, DO NOT SPARE THESE TREES.
FORESTS OF THE PENNICHUCK WATER WORKS, NASHUA, N. H.

FIG. 1.
WHITE PINE REPRODUCTION, SIXTEEN YEARS OLD.
NOTE THE HALF DOZEN VETERAN SEEDERS.

FIG. 2.
WHITE PINE PLANTED IN 1896. NOTE THE TEN-FOOT SCALE HELD ALOFT BY A SIX-FOOT MAN, ALSO THE YEARLY GROWTH AS SHOWN BY THE SWIRLS.
FORESTS OF THE PENNICHUCK WATER WORKS, NASHUA, N. H.

MR. BRONSON. Mr. Sullivan, you have my sympathy. [*Laughter.*] I have had water mills and I have had portable mills and I have had stationary mills. I think it all depends upon your situation. If you have got to haul your 300 000 feet any considerable distance to a mill, I shouldn't put up a water mill. Buy a portable mill for from $1 000 to $1 400, and then you can control it and handle it in such a way as to protect your timber land. The slab question is something to be considered, yet the value of the slabs will be eaten up, and more too, in the cartage of your logs to a water mill, if the distance is anything considerable, — that is, a mile or more. I would hardly think you could afford to put in a water mill unless your neighbors have a good many logs to bring in, if you have only 300 000 feet now and 60 000 feet a year to cut — for it would cost only $3 000 to construct and then you would have to maintain it. But I do think you can take a small portable mill, which you can move around upon your property from place to place as you need it and handle with your own men, and that it will pay you well for the investment.

MR. SULLIVAN. We have also looked at this phase of the question: Running through our lands is a chain of ponds, and there is an undeveloped water power. Adjacent to and on the slopes of these ponds are our pine forests. We can put our men on, cut and dump the logs on to the ice or into the ponds, for we do not use the water for our water supply, only for power purposes, — so we wouldn't have to do much teaming, only skidding; then float them up stream or down stream to the proposed mill located about midway on our chain of ponds. As you are no doubt aware, if you cut a lot of logs and leave them lying about without mill capacity, the borers will get into them and destroy the market value. Then if fire should burn over a large territory, and we have a mill right at hand, we are able thereby to obtain the highest possible per cent. in salvage. Again, we cut our trees, dump them into the pond, and cut them when we have a surplus of water and men. That is utilizing our water power and utilizing our men.

MR. BRONSON. I agree with you, Mr. Sullivan. The only fault I have got to find with your project is, you haven't got timber enough to pay you for carrying it out. Sixty thousand feet of lumber yearly would cost you, possibly, $300 to get to your mill;

and can you afford to put up a mill for $3 000, and handle it in that way, for $300 a year's saving? Probably you would save something by putting the logs into the pond and floating them down, but 60 000 feet is a very small amount of lumber to care for, and 60 000 feet of logs would make a very small showing in any pond; in fact 60 000 feet of logs would go into this room very nicely.

MR. SULLIVAN. We are a little altruistic up our way, and believe in doing something for our neighbors who are being fleeced right and left by some of the lumbermen by means of the pernicious log rule.

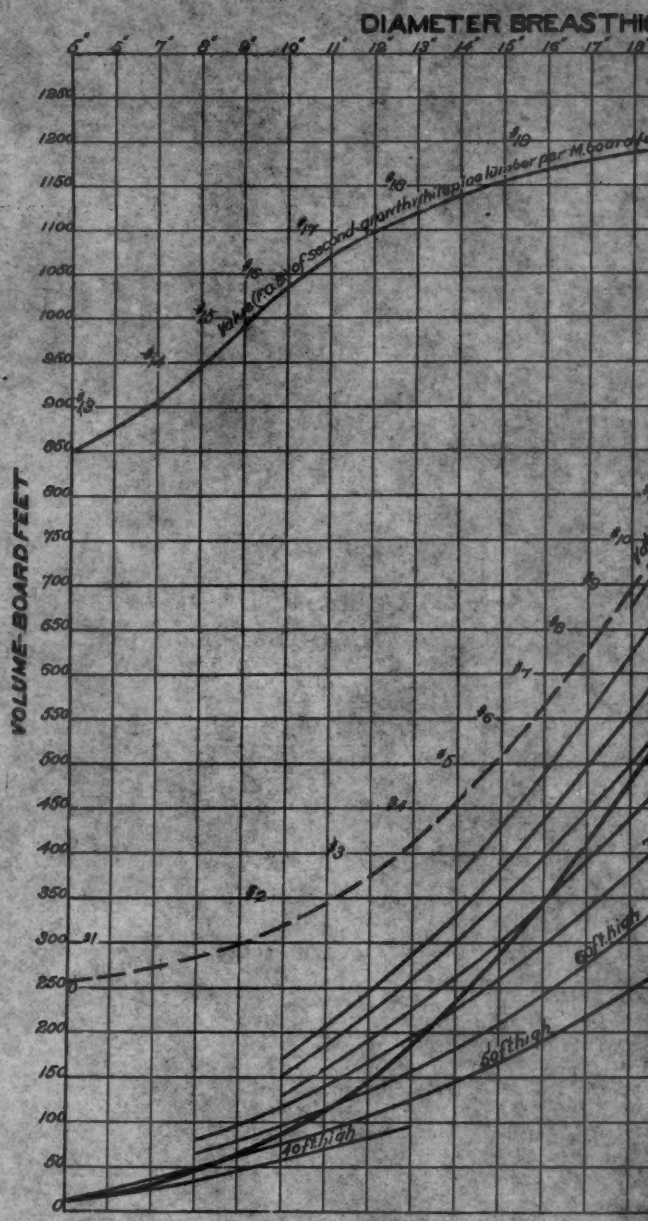
MR. BRONSON. By all means put in a mill then.

MR. SULLIVAN. I want to have this matter discussed fully. While gathering information, I made some charts to familiarize myself with regard to values. I don't know whether others would consider them worth anything or not. I brought them down here to show to any members that might be interested. One chart shows (Plate III) the volume board feet of trees from 5 inches up to 26 inches B.H.,* and from 40 to 120 feet in height, age about seventy-five years, also volume and value of an average tree. The upper curved line indicates the value (f.o.b.) of white pine lumber per thousand board feet.

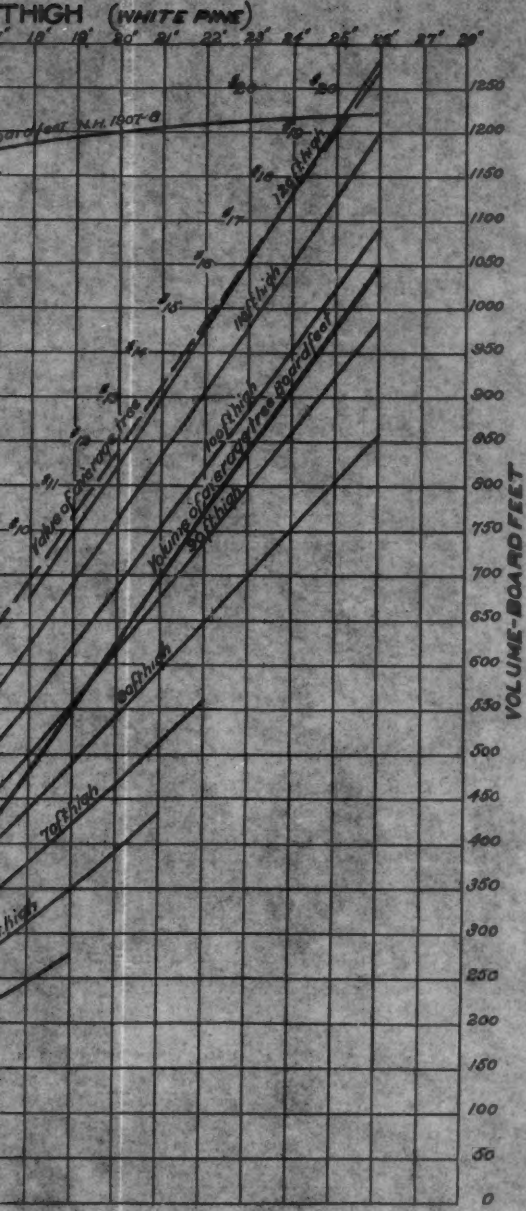
The other chart (Plate IV) shows diagrams of relation between volume of used length, with bark, in cubic feet and actual mill cut, in board feet, — white pine fifty to seventy-five years of age. Band saws cut a kerf one-eighth inch, circular saws cut a kerf one-quarter inch. Also the chart shows volume and value of average white-pine tree, and per cent. increase in volume and value for each inch growth in diameter B.H. The lower charted lines show the net increase board feet and the net increase in value for each additional inch growth in diameter B.H.

Gentlemen, I don't know whether they are worth much. They are compiled from "Forestry Reports" and may not have been culled from the knowledge boxes of the big lumber operators, for when you try to pry into the secrets of lumbering, you are mostly up against a set of closed books. Many of them are very successful lumbermen, but they keep their knowledge in their heads.

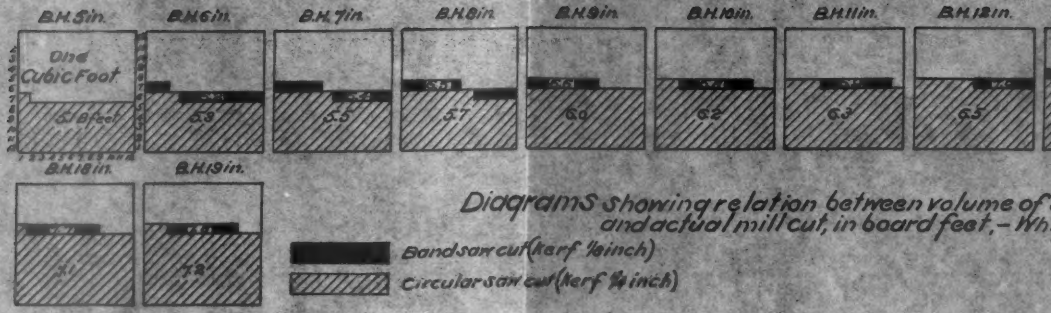
* Breast high.



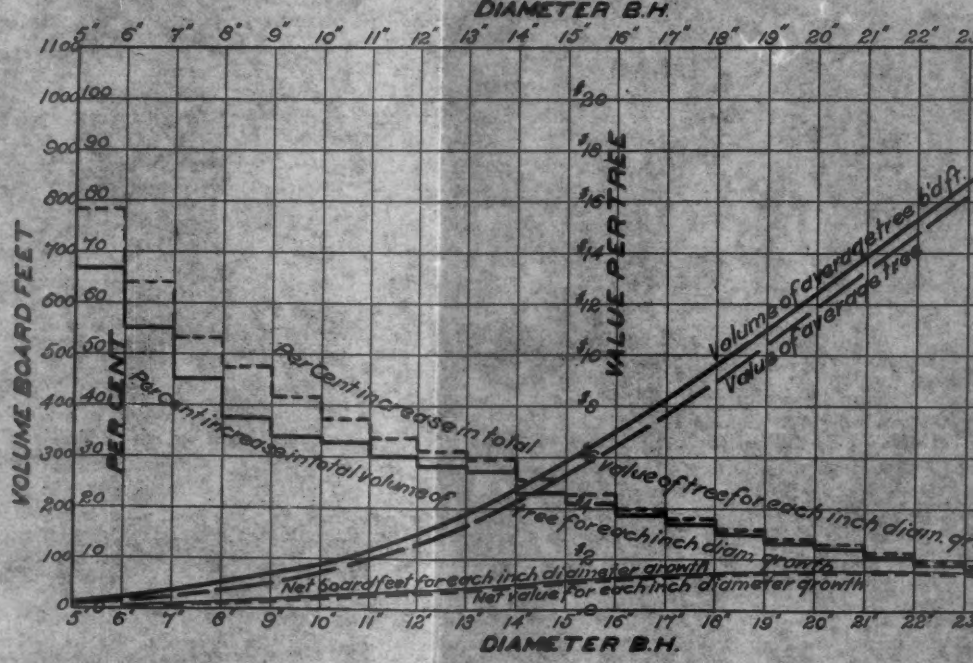
This chart shows the volume, in board feet, of trees from 5 in. to age about 75 years. Also the volume and value of an average tree of white pine lumber, per thousand board feet. Compiled and ch Commission for the years 1907–1908." Pennichuck Water Work Superintendent.

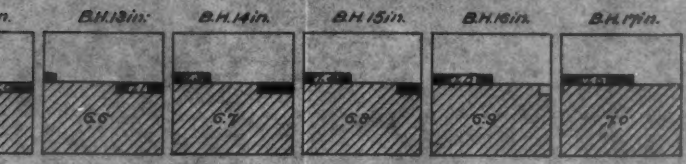


in. to 28 in. B.H., and from 40 ft. to 120 ft. in height,
e tree. The upper curve indicates the value (f.o.b.)
d charted from data in "Reports of N. H. Forestry
Works, Nashua, N. H., March, 1909, W. F. Sullivan,

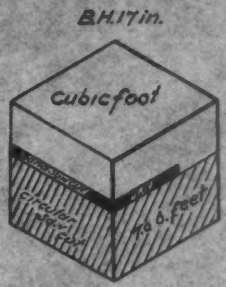


Diagrams showing relation between volume of ... and actual mill cut, in board feet. – Wh...

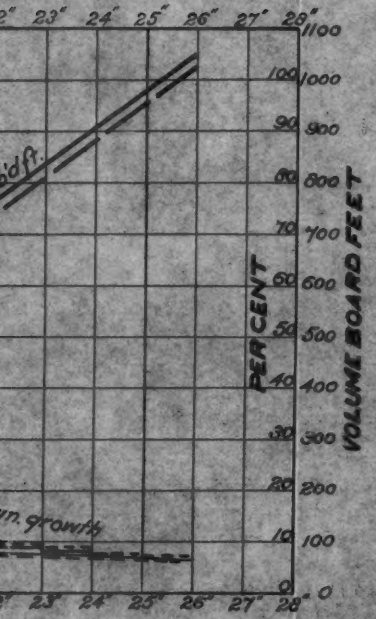

DIAMETER B.H.
5" 6" 7" 8" 9" 10" 11" 12" 13" 14" 15" 16" 17" 18" 19" 20" 21" 22"
VOLUME BOARD FEET
PER CENT
VALUE PER TREE
Volume of average tree b'd ft.
Value of average tree
Per Cent increase in total
Per Cent increase in total volume of
Value of tree for each inch diam. gr...
tree for each inch diam. growth
Net board feet for each inch diameter growth
Net value for each inch diameter growth
DIAMETER B.H.



e of used length, with bark, in cubic feet
- White Pine 50 to 75 years of age.



Explanation



DIAGRAM

Showing volume and value in average WHITE PINE tree, also the per cent increase in volume and value for each inch growth in diameter B.H. The lower charted lines shows the net increase board feet and the net increase in value for each additional inch growth in diameter B.H.

Compiled from authentic information in N.H. Forestry Reports and from Forest Measurements by C.A. Lyford.

Note:- Solid lines represent volumes.
Broken lines represent values.

Pennichuck Water Works
Nashua N.H.
Mar. 1909. W.F. Sullivan Supt.

They seldom use pencils. They go to a piece of timber land and, with their long experience and accurate knowledge at lumping, can place a value and obtain the timber, skin it, and their bank account generally shows that they made a good thing on the transaction. They seldom say how much. I do not blame them. They have devoted a lifetime in acquiring such knowledge. So, if you can find out from the lumbermen in New Hampshire whether the industry is a paying investment or not, you will do better than I can, gentlemen. I don't know about the Connecticut men. Certainly, Mr. Bronson has the information and he is generous with it here to-day. We outside the inner circle are in the pioneer stage, seeking useful knowledge pertaining to forestry and its branches, especially harvesting. We are into it and I don't know how we are to get out of it.

Foresters say that, " to obtain the largest returns from an investment in growing timber, it should be cut when it is financially mature. This is when the per cent. of increase in its stumpage value begins to fall below the interest rate obtainable from another investment of equal security." This principle of financial maturity works out thus in our forests, — that trees full grown have not a uniform diameter. Trees of equal height and age range from 8 to 26 inches diameter, breast high. I believe other things besides diameter determine the mature tree. The parasite and moss-covered tree, the tree afflicted with bores, the dying tree, and the financially mature tree, should be harvested at the proper time, like any other crop.

Do we not see from this the necessity for the individual or concern which has much growing timber to be ready with the facilities for harvesting?

Professor Hawley. Our experience has been that water company's men, while they can calk pipe in great shape, know about as much about working in the woods as some of the clerks in the stores. If any water company starts in to use their men in the woods, they have got to expect, I think, for the first five or six years to lose money on the proposition, because they may not be able to handle the woods work economically.

I want to disagree with Mr. Bronson a little bit on the mill proposition. It seems to him, he says, that you don't want to put

in a water-power mill, and he thinks you had better buy a portable mill. Now, if you are going to do anything on the mill question, I would advise putting in a water-power mill or renting a portable mill. I don't know just how it is up in New Hampshire, but in the southern part of Connecticut it is certainly an easy proposition to rent a portable mill. We find that we can get the most from our timber by renting a mill, having the sawing done at so much a thousand by the owner of the mill, and checking him up to see that we get what he saws. I would recommend renting a mill as the cheapest for the present. Or else, instead of putting in a portable mill, putting in a water-power mill. Since the tract contains a string of ponds, furnishing cheap water transportation for logs, it would be possible to bring the logs to a water-power mill, situated on one of these ponds, without heavy costs for teaming. It seems to me that a stationary water-power mill would be cheaper to run and keep in repair; and being more carefully housed would last longer than a portable mill.

MR. SULLIVAN. I must take issue with the professor with regard to the labor question. We thoroughly believe in reciprocity with Canada, and we have some of the best French Canadians in Nashua I ever saw. They are all natural-born woodsmen, and what they don't know about wood cutting and harvesting isn't worth knowing. I am only an infant in this matter. They have opened my eyes, and shown me a great many things. We have had the government forester up there, and he said, "Those fellows know their business." That is the kind of labor we have, and they know the wood business and the forestry business from A to Z — that is, without the technicalities which are now thrown around it. They can tell you almost anything you want to know. They are certainly able to cut and saw and take care of the by-products and all that, and as for harvesting cord wood, you can't beat them.

VIBRATION IN HOUSE SERVICES.

TOPICAL DISCUSSION.

[*March 9, 1910.*]

THE PRESIDENT. The members have been requested to present verbally any practical questions for discussion, and any member having anything he would like to bring up for discussion now has an opportunity to do so.

The following question has been presented by letter from Houlton, Me.

"We have a Goulds Triple-Geared Pump with rawhide pinions installed at our station, capacity 1 000 gallons per minute. We are very particular to keep all the valves in good order, but are troubled with a vibration, which sounds like the gears on the pump, in the residences located on the two 10-inch mains within 1 000 to 2 000 feet from the pumping station. On some services it is hardly noticeable, while on others it is very annoying. We have tried pressure reducers and air chambers with a little effect, but they do not remedy the trouble."

Can any one tell us what the trouble is at Houlton?

GEORGE F. MERRILL.* I suggest the possibility that the air chambers they have may be too small. We had the same experience on our pump at Greenfield. We found that the air chamber would fill with water, but by forcing air into it with an air pump we partially overcame the trouble.

SAMUEL A. AGNEW.† I would like to know where that water comes from. Is it from driven wells? I have had some trouble with my pumps that way, and have always found air in the water. As soon as the air came along, the gears began to rattle, but as soon as I got the air out of the water the rattling of the pumps stopped. I have noticed this in my pumps especially when the vacuum is running high — 25 inches or thereabouts.

MR. F. H. HAYES.‡ One of the troubles we have found in our

* Superintendent of Water Works, Greenfield, Mass.
† Superintendent of Scituate Water Works.
‡ Of the Platt Iron Works, Boston, Mass.

pumping station has been obviated, as Mr. Merrill says, by putting on air chambers and putting them on large enough. That helps a little, and then, as Mr. Agnew says in regard to air coming in with the water, if the chamber does not fill the plunger of the pump will hammer, and the hammering may be what is the trouble, possibly, more than the noise of the gears. Sometimes an air pump, by forcing air into the discharge chamber, will overcome that trouble, but the rawhide pinions ought to stop some of it. Is it a direct connected pump?

THE PRESIDENT. "Triple-Geared Pump" is all the letter says.

MR. HAYES. Do you know how it is driven?

THE PRESIDENT. I do not.

MR. HAYES. We have considerable trouble where we have had direct-connected pumps, that is, with an end gear from the motor, and we have overcome that with belting.

CHARLES N. TAYLOR.* This discussion interests me, because I have the same trouble. I am interested in a system of water works at Orono, Me. The pump is run by an electric motor. It has been installed about four years and we have had a great deal of trouble like this. We have enlarged our air chamber and now have a very large one, so that our trouble is not as great as it was. But at times the pounding is so great that on some lines the customers have to shut off the water at night in order to be able to sleep in the houses. I have another system at Milo, Me., and a few days ago I got a letter from a customer stating he had been obliged to shut the water off entirely, as he could not endure the noise. He had just had a new copper boiler put in and the pounding was so severe it pounded the top of the boiler right off. The worst trouble is on the higher level, where the pressure is the least, as the air evidently gets up there. Three boilers are said to have burst on this one street, although they had been tested to 200 pounds' pressure before they were installed. The nominal water pressure is only 40 pounds on this highest street, although at the pumps we have a pressure of about 100 pounds. I have been almost helpless to know what to do in regard to this trouble and I hope to get some information this afternoon regarding it.

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* Contracting Engineer, Wellesley, Mass.

FRANK L. FULLER.* There was considerable trouble at Marblehead at one time. We had a duplex pump of about 1 000 000 gallons' capacity, and when the pump was in operation there was a great deal of noise at a point two miles away. I don't think the trouble lasted a great while. In the upper part of the building of the Forest River Lead Works, which was on this same system, there was a great deal of pounding in the distribution system which was, I think, of 1-inch pipes.

They tried in every way to get the air out of the system, but the trouble continued for a long time though eventually subsiding. These troubles are, I think, difficult to locate and the cause is often hard to determine.

In my own house at Wellesley I have had periods when the pipes would " chug," as we call it, and rattle so that it would be very uncomfortable and unpleasant. I presume it is due to an accumulation of air, and after a while the trouble works out and the noise ceases.

GEORGE F. MERRILL. The way our trouble was partially obviated was by tapping the air chamber and putting on a gage to indicate when the chamber was full of water. We found that the air chamber would fill with water in about an hour's time and would then lose its efficiency. When this happens we force air into the chamber by means of a combination of check valves on the water end of the pump cylinder.

MR. H. L. THOMAS.† We have experienced precisely the same trouble that has been spoken of; like complaints of noise in the service pipes have come to us, and in a few cases occupants of houses have been greatly alarmed. We were at first perplexed to know the cause of the disturbance, and not until we took steps to put a water-column glass on the air chamber of the pump did we discover that this air chamber was filled with water. We have overcome the difficulty by admitting air into this chamber as often as necessary through a pipe connecting with the compressed-air starting outfit used in connection with our gas engine. Very recently, in response to a complaint that service pipes were again rattling, we found that through neglect on the part of one of our

* Civil Engineer, Boston, Mass.

† Assistant Superintendent of Water Company, Hingham, Mass.

engineers the air chamber had become filled with water as before; this was promptly forced out and the noise ceased.

MR. HAYES. If suggestions are in order, I would not follow out Mr. Merrill's idea, for if you introduce air into the suction, the plunger is liable to suffer. If the plunger hammers, it goes all through the system. It is a matter of experience and experiment to know how much air you are carrying in the chamber, but you get better results by putting the air directly into the air chamber on the discharge than you do by letting it through the plungers.

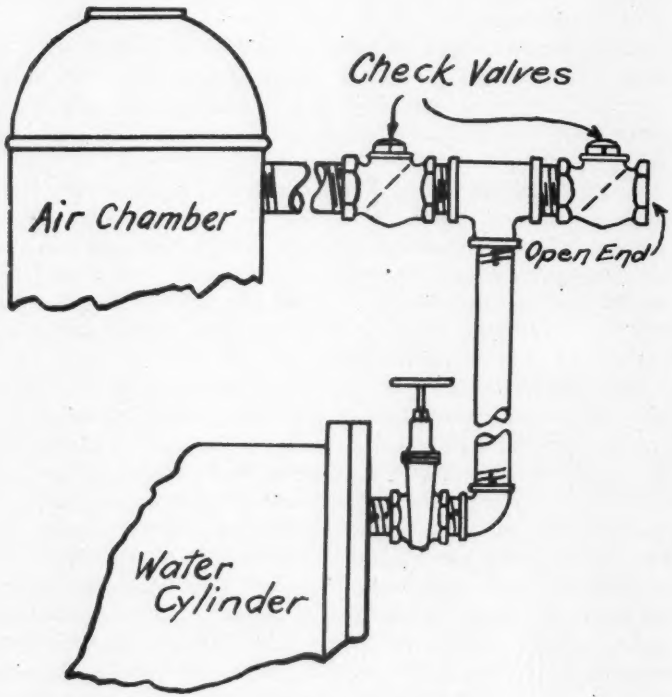

FIG. 1.

ARRANGEMENT OF CHECK VALVES TO TAKE PLACE OF AIR PUMP.

MR. MERRILL. I think the gentleman does not understand just how we piped the pump to accomplish the result. The water end of the pump cylinder was tapped, and a pipe with a gate valve was connected. This pipe was extended up to about the level of the top of the air chamber, connecting into a tee, with a check valve on either side, the branch from one side of the tee was connected to the air chamber and the other left open to take in air (Fig. 1), with the result that when the pump is running, if the gate valve on the water cylinder of the pump is opened, as the pump makes a suction stroke it takes in air through the check valve, and on the return stroke the check valve closes and the air is forced into the air chamber of the pump. In operation, a little water is forced out into the pipe which is forced up and down with each stroke of the pump and acts as a plunger. The gate valve can be gaged so that a very small amount of air can be taken in at each stroke. You can get the result without an air pump in this way.

A. E. MARTIN.* I don't believe that all these troubles are connected with pumping systems, for in Springfield we have this same chugging that Mr. Fuller has spoken of in Wellesley, with our gravity system, but I think perhaps more of those troubles are connected with pumping than with gravity systems. In our cases we almost invariably find that some ball cock is loose and its dancing up and down causes the chugging in the house.

MR. R. C. P. COGGESHALL.† I have had a similar experience. Our department workshop in New Bedford is located about 1 000 feet from the power house of the local electric railway company. Their feed-water supply is delivered into a large tank, the delivery being controlled by a large ball cock. At one time we were experiencing frequent abnormal shocks, which were not only recorded on the pressure gage, but the noise from them could be distinctly heard at the shops. We suspected that this ball cock might be out of order, and, on investigation, this proved to be the case. It was rectified, and the trouble ceased. There is no doubt but that a difficulty of that kind will cause a great commotion on a gravity system.

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* Superintendent of Water Works, Springfield, Mass.

† Superintendent of Water Works, New Bedford, Mass.

ROUND MULTIPLE AND STRAIGHT-READING REGISTERS FOR WATER METERS.

TOPICAL DISCUSSION.

[*April 13, 1910.*]

MR. GEORGE A. STACY.* *Mr. President,* — I would like to inquire what advantages a round multiple register for a water meter has over a straight-reading register, and, if there are none, why that kind of a register should be used. I think we should not tolerate anything about our works that inconveniences us, when there is something else presented which is decidedly an improvement. I cannot see, therefore, why we should be asked to use a multiple dial on the register of a water meter, when we have a straight-reading dial that does not present any of the complications or difficulties in reading which we have with the other.

I do not think any drummer would care to go into an engine room where the engineer has a straight-reading register for the revolution counter of his engine and ask him to substitute a multiple dial, where he would sometimes have to use almost higher mathematics to find out how many turns his engine had made.

If the two dials were to be put on the side of a wall, with good light where they could be easily read, I think that there would be no question under these conditions as to which we would use. When we come to consider, therefore, the position in which most meters are apt to be put, with the bad light and all the other difficulties of reading, it has always been a wonder to me why the meter salesman should even suggest the use of a round multiple dial.

MR. J. A. TILDEN.† *Mr. President and Gentlemen of the New England Water Works Association,* — Speaking for meter manufacturers in general rather than for myself or my company in particular, I should say in answer to Mr. Stacy's question, that as a simple business proposition we try, if we make two types of a

* Superintendent of Water Works, Marlboro, Mass.
† Of the Hersey Manufacturing Company, Boston, Mass.

thing, to find out which is wanted, particularly if preference is anywhere near evenly divided. There is a large difference of opinion upon this question; for the round dial still has a great many warm friends; while a great many people prefer the straight-reading dial. That is why we ask whether dials shall be the old style round reading, or straight reading, for we, as manufacturers, feel obliged to find out what kind is wanted and to be ready to furnish it.

It is very true that some of the companies incline to one kind and some to the other, and so unless a particular kind of dial is specified with the order, one company will send out round dials and another company will send out straight-reading dials. Oftentimes it resolves itself merely to a question of judgment as to which kind is really wanted.

Mechanically, of course, there is this difference. The old round-reading dial is a perfectly simple piece of gearing, an entirely rudimentary piece of mechanism. There is nothing to it but a plain train of gears.

The straight-reading dial, on the other hand, operates on an intermittent system, or what is called a mutilated system of gearing; that is to say, the teeth are not continuous all the way around the wheels as they are in the simple round train, but are mutilated, several of the teeth being missing, thus giving the intermittent motion. This form of gearing is not as simple as the plain train, and under certain conditions is more liable to be clogged by dirt and by corrosion. The old plain round train will therefore operate, and will continue to operate, as you all know, under conditions which will put the straight-reading train out of business.

There are other conditions, however, under which the straight-reading train will work satisfactorily for years, and that is where the gearing is thoroughly protected from dirt, corrosion, vermin, and moisture. These conditions presuppose that, among other things, the dial glasses shall remain intact, and I imagine that one of the reasons why Mr. Stacy has met with success in using straight-reading dials is because he has been careful to see that broken glasses are promptly replaced.

Coming back now to the first proposition, a meter manufacturer

furnishes one man with round-reading dials because he likes them — very likely because he has found them very nearly fool-proof except for reading, as Mr. Stacy has just called to your attention; and he sells to another man straight-reading dials because perhaps he makes it a point to see that they have rather more than ordinary care.

THE PRESIDENT. The man who reads the meters for our department has complained that with the straight-reading dial when a figure is partly over he cannot tell what the reading is.

CLEANING WATER MAINS.

TOPICAL DISCUSSION.

[*April 13, 1910.*]

MR. E. C. BROOKS.* *Gentlemen,* — As some of you probably know, I gave at a previous meeting our experience at Cambridge, which was very slight. I understand that the practice of pipe cleaning prevails quite extensively in the West and in the South; and in those sections very long lines of mains have been successfully cleaned and at a very trifling cost, compared with the cost for relaying.

We in Cambridge have only had the experience of cleaning 1 800 feet of 6-inch pipe, which had been in use for about thirty years. It was cleaned at a very slight expense and very effectively. I see no reason why the practice could not be well applied to a great deal of our pipe in New England, especially in the older works. I might say that we have a supply conduit some three miles in length with which we are contemplating doing something of this sort during the coming season, should we be fortunate enough to get an appropriation for it. I think it can be very easily demonstrated that it would be money well invested.

MR. F. A. MCINNES (*by letter*).† Boston's experience in cleaning water pipes by machine was in 1884, long before my connection with the water department. I have gathered the following facts in regard to the experience gained at that time. The pipes were cleaned satisfactorily, and their capacity to deliver water was greatly increased, but the expense was prohibitive. The greater part of this expense arose from the fact that every service pipe was clogged up in the operation. Another trouble was that the machine then used would not pass through gates or Lowry hydrants on the line of pipe. No doubt this difficulty would not obtain with a modern machine. As a man who worked on the cleaning expressed it to me to-day, " It took an army of plumbers

* Superintendent of Water Works, Cambridge, Mass.
† Assistant City Engineer, Boston, Mass.

to follow the work." Personally, I have no doubt that pipes can be successfully cleaned by modern methods when the material to be removed consists principally of silt, mud, or something of that nature. There is more doubt, however, of the economy of the process when the material in the pipe is largely composed, as it is in Boston, of tubercles partly formed from the metal of the pipe together with sedimentary deposits. In our case, the material scraped out would be harder and much more likely to make serious trouble with services than would be the case if the iron were less affected by the water.

I was informed this summer by officials of the Louisville, Ky., water works that pipe cleaning is an unqualified success in that city. They now do the work themselves at a cost materially less than that charged by the pipe-cleaning people.

MR. BROOKS. I would say, Mr. President, in regard to stopping the services, that this street where the main was cleaned is a residential street, and I do not think we had trouble on more than three or four supplies on the street. That trouble was only temporary. It was easily remedied by putting a force pump on to the faucet and forcing the material back into the main.

MR. MCKENZIE. I want to ask Mr. Brooks if there isn't any trouble from this pipe-cleaning machine catching on the plugs that as a rule project an inch or half an inch inside the pipe.

MR. BROOKS. The sheet steel scrapers of the pipe-cleaning arrangement which was used were so arranged that they would bend and give way before the end of any service cock, and we had no trouble at all. There were many supplies in the street, and there was no instance of any damage to any one of them in any way, shape, or form.

MR. F. T. KEMBLE.* I would like to ask Mr. Brooks whether he found any tuberculous growth in any of the pipe he cleaned?

MR. BROOKS. I should day there was nearly a tip-cart load of tubercles came out of this 6-inch line.

MR. KEMBLE. I had an idea that anything which would take off the tubercles might trouble the corporation taps, but it appears that it didn't.

MR. BROOKS. You understand that now, in scraping, they

* Secretary New Rochelle Water Company, New York.

allow a good generous jet of water to flow through, and, in fact, in most cases they drive the scraper with the water pressure behind, and that tends to keep the light stuff going ahead very rapidly. Unless there is water being drawn, or the attempt is being made to draw it from the main at the time, I don't see that there is much tendency for the material to be drawn into the supply pipes.

MR. KEMBLE. Did you use one of these pipe-cleaning crews, or did you set up a plant of your own?

MR. BROOKS. The company sent their men.

MR. ROBERT SHIRLEY.* I saw them cleaning pipe out in Louisville, and it was mostly mud which came out of the pipe. There was so much of it that I asked if it was a sewer. So the gentleman with whom I was speaking took me one side and said, " Between you and me, the people think it is a sewer, but it is really the water main. [*Laughter.*] I saw them get out a baseball and a bat [*laughter*], but the most of the material was mud and silt.

MR. ALLEN HAZEN.† A few years ago I had an opportunity to see the work of pipe cleaning carried out on some pipes which had been cleaned through a long term of years. I also had an opportunity to study these pipes and note about what they were doing. The coating had largely disappeared with repeated scrapings, and the pipe corroded rapidly and the cleaning had to be repeated at frequent intervals in order to keep up the carrying capacity.

One of the most important things connected with the procedure was that part of the iron that became corroded always went into solution in the water. This iron came out in the services in the city, producing what is called the " red-water " trouble, and in this case it was rather serious. Cleaning the pipes seemed to be clearly an important contributing cause of the red-water trouble in this case.

THEODORE A. LEISEN, ESQ.‡ (*by letter*). The Louisville Water Company, of Louisville, Ky., has cleaned over one hundred miles of water mains during the past two years. This work embraces mains varying in diameter from 4 inches to 16 inches, the

* Of the Chapman Valve Manufacturing Company, Indian Orchard, Mass.
† Civil Engineer, New York City.
‡ Chief Engineer and Superintendent Water Company, Louisville, Ky.

greater part of the work having been confined to 4-inch and 6-inch lines. Part of this work was done under contract with several different companies and part by the regular force of the water company.

Owing to the excessive turbidity of the Ohio River water a large amount of silt was deposited in all of the water mains throughout the city, and as the filter plant was placed in successful operation in July, 1909, it was thought desirable to clean the greater portion of the distribution system for sanitary reasons, and it was also found necessary to clean them in order to provide a better supply in many sections of the city, both with a view to fire protection and for general purposes. The results have been very satisfactory, as the carrying capacity of the mains in many cases has been more than doubled, actual tests having shown a gain of from twenty-five per cent. to over one hundred per cent. in the flow through mains after cleaning. While the removal of the silt was the main object sought for, it has been found that a large amount of tubercles have been also removed.

The work of cleaning does not appear to have materially damaged the inner coating of the pipes, as evidenced by some sections cut out after the operation of cleaning, which show a comparatively clean well-coated interior. No trouble has been experienced in damage to the taps or ferrules. There has been some trouble in having the service pipes clogged temporarily after cleaning, due principally to the fact that the services were opened during the time of actual operation, thereby tending to draw a mass of tubercles into the service pipes. Where this has occurred a force pump on the service pipes invariably removes the material, thereby remedying the trouble at a very slight expense.

SECONDARY WATER SUPPLIES, THEIR DANGERS AND VALUE.

TOPICAL DISCUSSION.

[*April 13, 1910.*]

MR. E. E. LOCHRIDGE.* *Mr. President and Gentlemen of the Association,* — All that I will attempt to do to open this discussion will be to make a statement in regard to what these secondary supplies are, and then let some of you who have had a great deal more experience with them than I have had say something about them.

The secondary supplies to which objection is raised are those supplies which are taken from unprotected or polluted sources and pumped directly into the same mains that are used by the city for their regular supply pipes, thus bringing in the possibility of the use, by regular consumers, of a water which is unprotected and usually polluted. A city may spend several hundred thousand dollars to develop a very clean watershed, guarding against all pollution as we do in Springfield, and then filtering besides, so as to obtain a water which we want to be regarded as thoroughly safe at all times. There are within the city, along some river or other water courses, several factories which are willing to take all the water they need from the city and pay for it, but which have their system of piping within the mill supplied, perhaps, from a polluted source which is separated from the pipes which furnish them with the city water only by a check-valve. They pump this polluted water against this valve in case of fire, which is the demand on the part of the insurance people, or for the purpose of securing additional water for a portion of their use. If, for example, the city pressure is 60 pounds, and the fire service to be developed is 100 pounds, when this pressure is developed by the pump taking the water from the river or other unprotected supply, the check-valve is closed, as the pressure is greater on the mill side.

In the case where the city pressure is ordinarily high enough for

*Chief Engineer, Springfield Water Department, Springfield, Mass.

fire protection, as it is in Springfield, but drops down occasionally, as it has twice during the past year, they would again be required to put up the pressure of water against a check-valve so as not to pump it through the mill and outside.

The objections to this system come in the seating of this valve. You all know the way in which any valve will seat, even a valve with carefully prepared faces that have to be driven home. Tubercles and growths, or any small stick, refuse, stones, or sand, which get into the pipe at the time of laying, or at any other time, getting on the face of the valve will prevent its perfect closing. This has been obviated in part, in recent years, by a system of double check-valves. We have none of these in Springfield, so I cannot speak very intelligently as to their practical working. I think in practice there will be none to deny that the old check-valve is a fairly dangerous mechanism.

Here we have, then, the matter stated simply: The piping in the mill is the piping through which you must furnish them the water. The mill is required to have an additional supply, on account of the insurance rate, and the question becomes purely one of expense, as to whether those same pipes within the mill should be utilized for the fire supply, and if so, whether they should be supplied with pure water which you can furnish, or see that is furnished, as a secondary supply, or with a polluted water. The question then, to state it broadly, is simply one of fire protection.

What then, can be done to enable this secondary supply to be used, and what can be done to safeguard the interests of the consumers? I should put down as the first duty of the water-works engineer or superintendent that of furnishing water that can be relied upon to their users. If you are expending a good deal of money to make a supply safe, you should see that it is safe at all times. Therefore you must see that polluted river water does not enter the pipes of your system outside of the mill, leaving out for the present all discussion of the use within the mill. I believe that this problem will work itself out within a few years, and new methods will be devised to prevent the possibility of this extra pressure forcing water by the check valve.

In talking with some of the representatives of the various industries in Springfield, I find that nearly all of them are heartily in

accord with the water board. They do not want to do anything which will endanger any of their employees or endanger the city.

Of the 62 Springfield industries that I studied, only 5 check against the city water at the present time with water from a polluted source, — Connecticut, Mill, or Chicopee rivers. The whole question is on those of that character. These 62, outside of the 5 which do check, including some of our largest industries, have developed their secondary supply for the sprinkler system and fire hose by means of tanks on the roof. The department can meet such cases at least half way. It can agree to furnish free all of the water which is to be used for fire protection, if the mills will eliminate their other supply, and this will in a large measure remove the objection on the ground of additional expense.

Another class of users are those who regularly use water from the river or nearby supply and have an auxiliary branch that can be drawn from the city mains. In such cases, for example, a certain large power plant, which does not use the city water unless the private supply is short or there is something wrong with the pump, double positive valves can be arranged with an open tap between, which under proper inspection, I believe, can be made to serve the purpose.

In one of the main cases which I studied, and one which bothered me most, on presenting the matter to the insurance companies, I was told that it simply came to a matter of putting in a separate tank, and a portion of the pipes separately, which would supply with the city water all of the sprinklers from the tank. I was assured by them that such an arrangement would make no difference in the rates.

In regard to the reasons for keeping out the outside water, I don't know that it is necessary to say much. The chief water-borne disease that we can find definite records of, and that we need to look out for, is typhoid. In one plant in Springfield, where there is a check-valve, I find that warnings have been posted that the water is not to be used, because this danger is recognized. In this same plant they have had one case of typhoid which they lay to this source.

There have been a number of specific cases where the check-

valves have failed to operate, and one of them was a recent case in Chicopee, where the check-valve failed to properly keep out the water from the river.

The insurance men have met us more than half way in every instance, and have been alive to the situation and willing to do what they could to better the conditions. I believe that they all will shortly come to our assistance in the elimination of the evils. The very fact that those industries which are located where they cannot get the city water have been taken care of by them, seems to me a fair argument that if they should want water regularly for fire protection they should have it in an independent system. Even though the development may be slow, it is sure to come.

THE PRESIDENT. We had hoped to have Mr. Thomas with us to-day, to tell us something of the experience they have had with check-valves in the city of Lowell. As he is not here, perhaps Mr. Sullivan, of Nashua, who was in Lowell at the time, can tell us something about that experience.

MR. WILLIAM F. SULLIVAN.* Mr. President, I am afraid I shall make a poor substitute for Mr. Thomas. Probably many of the members of this Association are somewhat familiar with the circumstances at the time referred to. I am not going to be very specific about names or places, sufficient to say that the failure of a check-valve kept a number of people on the run for quite awhile.

The facts, in regard to the Lowell case, are that back in 1849 the Locks and Canals Company, which is a sort of parent corporation supplying water power, fire service, engineering, etc., to the larger corporations, constructed a reservoir to supply water to the mills. In 1871 the city of Lowell put in a municipal supply, the city's low service reservoir being about 50 feet lower than that of the Locks and Canals. About 1876 the city laid a large supply pipe practically parallel to and adjacent to that supplying the large corporations. Since 1876 the mills from time to time put in 17 connections with check-valves of different designs, 15, 12-inch and 2, 8-inch, I believe.

Matters went along smoothly until about 1903, when a fire occurred in one corporation. It happened on a Saturday night in the summer time, when many of the mill officials, familiar with

* Engineer and Superintendent, Pennichuck Water Works, Nashua, N. H.

details, were on vacations. Things got a little bit confused. The yard hydrant service and sprinklers drew upon the corporation supply so much that their pressure dropped below the city pressure, thus letting in the city supply in large quantities through these different checks. The fire was extinguished, and an engineer in one of the mills started up a fire pump. The canals were drawn off, and it is said that the suction for this fire pump was in a small basin under one of the mills and within a few hundred feet of a sewer outlet. Again it was contended that after the fire was out the fire pumps could neither replenish the water in the corporation reservoir nor increase the pressure on the corporation lines. Investigation showed that one of the 12-inch checks failed to work properly, and that the pumpage had been going back through the check-valve for an uncertain period of time. I believe nobody dared to say, or wanted to say, how much water passed backwards through the faulty check. Of course just as soon as it was found out that the check did not operate properly, the gate was closed.

Whether from the result of that mishap or some other cause, the typhoid fever cases jumped from an average of less than 2 per week to 75 the third week after. The city authorities blew out the mains and had the State Board of Health investigate, and samples were taken at different parts of the city for chemical and bacteriological examination. Some months afterward a well-known old-time lawyer in the city, who claimed he was affected by drinking city water on the day following the fire, sued the city and the Locks and Canals jointly, and wanted a trial by jury. It is said that somebody else thought justice would be served by other means, and I believe it was actually said that some of the defendant's witnesses fled from the process server. Some jocosely remarked that they were fugitives from justice.

After a while, like "Jarndyce and Jarndyce," the case went before a master in chancery, and I understand there it reposes. A great array of legal, engineering, and expert talent have been talking on this check-valve ever since.

Some years after the entry of the case the plaintiff died, and his administrator took up the case, and is still prosecuting and waiting for a decision. Whether this man ever drank water and contracted any ailment at that time is up to the Court to say. Some of us

have our own opinions which it might not be right to express at this time, as it might appear to be prejudging the case. Nevertheless, the board of health records show at that time an increase from less than 2 to 75 cases of typhoid per week. I do not say these cases were caused by the water. I don't dare to! The case isn't settled yet.

It was somewhat customary, years ago, to connect secondary supplies with the primary supplies in such a way that the secondary supply could be pumped directly into that of the city or town. City and corporation officials believed that such a union was of mutual advantage. The corporations would get the benefit of the city supply and the city would get the benefit of the corporation supply and pumps, in case of a breakdown or shortage in the city's supply. That was before the time of water sanitation, filtration, and purification. Times and methods have changed and the method of by-passing a check-valve and having a sealed gate in the by-pass, of by-passing a gate with a check-valve, is a practice not commonly adopted now. Of course with the by-pass the personal element always is present, and the gate after operation might not be closed absolutely tight, and during a fire test there would be liability of a large or small stream of polluted water getting back into the city mains.

In Nashua, within a comparatively short time, there was a corporation which had a 12-inch fire pipe with a 12-inch check-valve. As is customary, the insurance inspectors came around at the regular interval for inspection. One of the things they do is to try out the yard hydrants, etc., with city water. As we do not charge them for it, it is a case of let them blow away.

The next step is to try the fire pump. On this occasion, we got a hurry-up call. They couldn't increase the pressure over the normal, which ordinarily they ought to increase by forty pounds. We shut the gates and blew off the mains adjacent to the mills. Casually we were informed there was some intestinal sickness, but we never saw or heard of it. The people who lived in proximity to the mills didn't know anything about the test or the cause of the sickness, if there was any. The insurance folks, the corporation, and ourselves were content with the old adage, "Least said, soonest mended." We cannot, nevertheless, shut our eyes to the

fact that such occurrences are a menace to city and town supplies. Inspection of this check-valve when the cover was taken off, showed that the flapper was locked up, being wedged with tubercles. This check had been in for over twenty years and had never been examined.

In another New Hampshire city there was an arrangement by which the corporation fire pumps could pump into the city mains. The mill agent is reported to have said that such an arrangement was at the request of the city authorities. They had a fire that lasted many hours, and the fire department officials opened or had opened the gate connecting the city with the corporation and requested the mill people to pump into the mains. This was all unknown to the superintendent of the water works. The inevitable result of such action was a large dose of polluted water, much sickness, and fear of a typhoid fever epidemic.

On the smaller connections to buildings, factories, and mills supplying water direct to boilers, what superintendent of water works has not found that the check-valves do not hold? Generally the result is loss of water in the boilers, twisted and distorted disks and pistons on the meters.

In Nashua we are trying to divorce primary and secondary supplies absolutely. We believe it to be an unholy alliance. We have divorced most of them except where the corporations and insurance people have met us halfway by compromising and putting in safety devices. I want to say right here that these insurance men are thoroughly trained and on to their jobs all the time, and when you run up against them, you run up against some of the brightest and smartest fellows in the business. Where we are unable to absolutely separate the supplies on account of real hardship and expense, we allow double check-valves. We say that the supplies must be separated. If an agreement is not reached by means of double checking, we cut off the supply.

After the failure of the check-valve at Lowell, the corporations increased their pipe capacity from their reservoir, and are now self-contained, as it were, and can take care of themselves inside the mill yards. The city of Lowell increased the number of hydrants outside the mill yards.

Whenever there is a chance of polluting a city supply, I believe

such changes are imperative. If corporations do not want to assume the entire responsibility of a fire supply, and are desirous of continuing a secondary supply in union with the city's, let them build tanks or reservoirs of ample size and capacity, and keep them filled with the water furnished to the inhabitants, the water works to adopt rules regarding drawing off, cleaning, etc. Let them take this reserve supply, fill up their tanks and run their fire pumps with city water, and not with polluted water.

As I have said, we have compromised and put in the double check system. In addition to double checking, we also want a check on the water passing through the fire pipes. Our method is to put on a straight commercial check, not the kind that sticks. Back of that, towards the inlet, we put on a Hersey detector meter. On the side and around the checks we have a testing apparatus so arranged that we can increase the pressure on either check and tell from the gages if any water is going back. The telltale meter on the detector informs us if the flapper is off its seat. If the water is going forward, it is up to the mill officials to look into the matter. If it is going backwards, it is time for the water works people to stop it. There is also an electrical connection to a bell which will ring in case of the failure of a check-valve. This was worked out in conjunction with the insurance people for these particular places, and no doubt could be employed under similar conditions elsewhere.

You probably heard Mr. Coggeshall, of New Bedford, tell about the salt water being pumped into his mains, causing the water in the fire engines boilers to foam. I am half inclined to believe, as Mr. Brooks once remarked, that check-valves were the invention of the devil! The members of this Association once visited a valve factory where they also manufactured check-valves, and there were some fine goods on exhibition. I went over to a 6-inch check-valve that had the cover off. It was soon after the Lowell affair, and I was curious, and desirous of learning something about check-valves. I pulled up the flapper and it stuck. I pushed it down again and pulled it up. Again it stuck. Several other gentlemen came over to where the check-valve was and looked it over carefully. I called the attention of the superintendent, who had recently taken charge. He saw at a glance that

there was something inherently wrong in the design and construction of that check-valve, and immediately ordered that particular exhibit to be shelved.

I have often wondered how many check-valves of that design were in use, and if every time water was forced through them in large quantities so that the flapper was raised to its full height, if it would stick.

Another grievance against check-valves has been that they have been put into the ground without a chamber or manhole, and quite often there is no record of their location. I have known cases where the mill people were uncertain whether there was a check on the line. In such cases it would have to be determined by testing, and it would be almost impossible, sometimes, for the so-called oldest employee in the mill to locate the valve.

Mr. E. C. Brooks.* I thoroughly agree with Mr. Sullivan. I would say that in Cambridge we get over the trouble from a double supply very nicely by having inserted in the regulations for fire supplies that no pipe on the premises shall be so arranged as to take water from any other source than from the Cambridge supply. They have a number of brick or concrete cisterns of ample capacity, — 100 000 gallons, for instance,— with a 6-inch line running into them, and the fire pump is connected directly with the cistern, drips of every kind being excluded. I think in that way you can safeguard the secondary supply very well.

In regard to check-valves, I would say that two are only twice as good as one, and if one isn't worth anything you can judge what two are worth.

In regard to positive valves, which Mr. Lochridge spoke of, I had occasion some time ago, in connection with Mr. Williams, the chief mechanical engineer of the Boston Elevated, to arrange a system of piping whereby they could supply their boilers at the power station either from Charles River, the water in which since the construction of the dam has lost enough of its salinity so that it can be used for boiler purposes, or from the city water. By designing a 3-way cock, giving sufficient space between the openings so it would be impossible to have the cock open on both supplies at the same time, it was easy to provide a means of

* Superintendent of Water Works, Cambridge, Mass.

accomplishing that end without any difficulty. I think that the secondary supply always has its dangers, and that we ought to be on the lookout against fire pumps taking anything in the way of polluted water which is liable to be forced back into the mains.

While I am talking about fire pumps, I would say that the fire insurance people have passed fire pumps as being in good condition when from the running of the pumps there has been a ram on the mains in the immediate vicinity sufficient to disturb the piping in the buildings of adjacent property owners, and that that could only come from imperfect suction valves; and that it isn't always safe to say that because a pump runs it is all right. Unless you have got a gage on the suction side of your pump that is sensitive enough to show the variation in pressure, I don't think you can judge really of the condition of the fire pump. I have had two cases recently where that has been the trouble.

MR. JOHN J. KIRKPATRICK.* Mr. President, we have about 100 check-valves located on services that were put in for the purposes of providing fire protection to our mills and factories. With but two or three exceptions have we found fault with the operation of those check-valves. Those two or three exceptions, however, have convinced us that the operation of the check-valve is most successful when there is a gate valve behind it closed tight.

Last year, because of the changing of the grade at a railroad crossing, we had occasion to dig up a check-valve which was on the pipe line between the high-service section and the low-service section. We have a reservoir which supplies the higher elevations of the city that is called the High Service Reservoir, the lower elevations being supplied from other reservoirs. The check-valve was a small one, an 8-inch, and as we dug down to it we plainly heard the water passing through from the higher pressure to the lower pressure. When the check-valve was pulled out it was found to be so corroded and filled up with silt and rust that it would not close. That check-valve was not replaced, a gate valve being put there instead.

The check-valves that we have on the services for the mills are, of course, put in by the mill owners, all of whom use fire pumps.

* Superintendent of Water Works, Holyoke, Mass.

They pump water either from the Connecticut River or from the canal, the water in the canal coming from the river above the dam.

The insurance inspectors, when they are making their annual tests, are required by our board of water commissioners to first test the fire pump. They do this after closing the gate valve that is located between the check-valve and the street main. After the fire pump is tested the hydrants in the mill yard are opened to let out any river or canal water that may be in the sprinkler system at a higher elevation than that at which the hydrants are laid. This water will run out slowly, as the pressure seldom exceeds 12 or 15 pounds. After that operation the hydrants in the mill yard and the sprinkler outlets are opened, and the whole system is flushed out with city water.

The insurance companies have shown a disposition to comply with the rules of the water board, and up to date the inspectors have done everything they were requested to do while making their tests.

MR. ERMON M. PECK.* Here in Hartford we have nine plants the pipes of which are fitted with double check-valves. There are altogether 13 of these double check devices in use here, one of the plants having 3, two others having 2 each, and six having 1 each. I want to pay a just tribute to the insurance men and to the manufacturers for the manner in which the placing of those valves in our city was effected. The matter was adjusted most harmoniously, all parties working together with the very best will and intention towards the water department, and the consequence was the whole thing passed through with absolutely no friction whatever. There was some delay in getting the devices installed. In some places the construction was very expensive, and there was some delay in getting the necessary fittings and appliances; but otherwise everything went very nicely.

The conditions here in Hartford, in some respects, are unusual. We have to our credit the statement of the local board of health that no case of typhoid fever has ever been directly traced to our water supply. But the fact that Hartford has had no typhoid fever epidemic is no proof whatever that it may not have one, because they do occur in other places. During the time that we

* Distribution Engineer, Hartford Water Works, Connecticut.

were installing these new check-valves, an old type of check-valve was taken out, which gave evidence of having leaked considerably; it was one which had been used between the polluted supply of the Park River and our regular city supply.

We have established the custom here in Hartford of testing the valves monthly. We have an engineer who goes around and tests each one of them every month, and the manufacturers very gladly bear the expense of it.

I thought that just a word regarding the check that we use here would be interesting. We use a special check, one which was settled upon between the water department and the insurance men, and it was made by the Pratt & Cady Company. I am very glad that Mr. Robert Shirley, the former engineer of the Pratt & Cady Company, is here this afternoon. I think he will be glad to say a few words regarding the construction and design of this check, and I believe you will be interested in listening to him.

MR. ROBERT SHIRLEY.* This check-valve, as Mr. Peck has said, had to be satisfactory to the insurance people and to Mr. Peck himself. We had found from experience that a properly made rubber disk had good lasting qualities, as we had taken samples of disks from different valves which had been in use for fifteen years, and they were in good condition. So we decided to make the disk of rubber. It is very seldom you can find a standard check tight — by standard, I mean a regular commercial check bought in the open market. It is almost a physical impossibility to make and keep it tight under low pressure, and these valves generally work under low pressure as far as the disk is concerned. For instance, if the city pressure is 80 pounds, and the pumps maintain 90 pounds, the pressure holding the disk to its seat would be 10 pounds. It is important, therefore, that the check should be tight when tested, with practically no pressure against the disk.

As you all know, it is the pressure against the disk which holds the disk to the seat; consequently, if you get a scratch on the brass face of your disk, your check is no longer tight. We found that under 50 pounds pressure, with a rubber disk bringing up against a flat brass seat, the check would leak, the rubber having

* Works Manager, Chapman Valve Manufacturing Company, Indian Orchard, Mass.

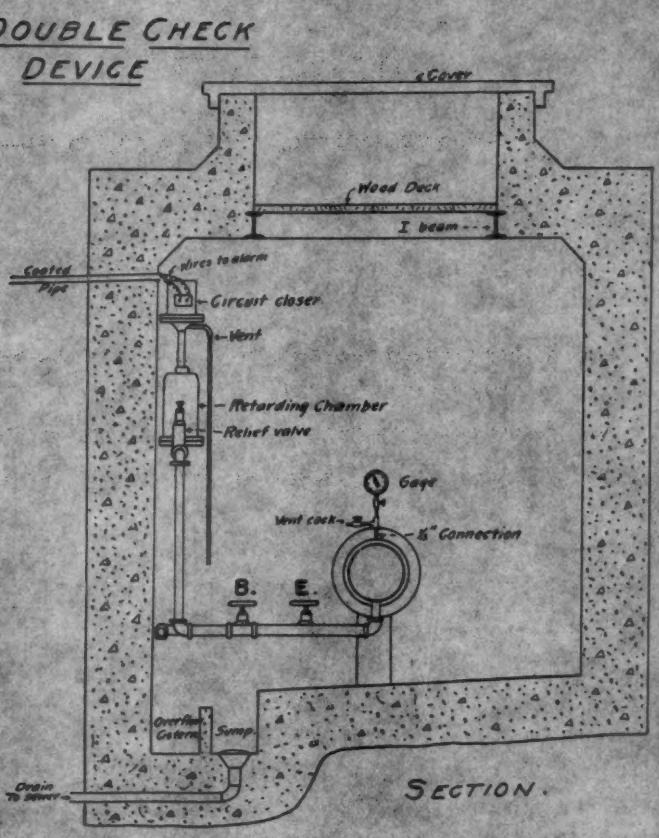


FIG. 1. CROSS SECTION.

DOUBLE CHECK DEVICE AS USED BY TH

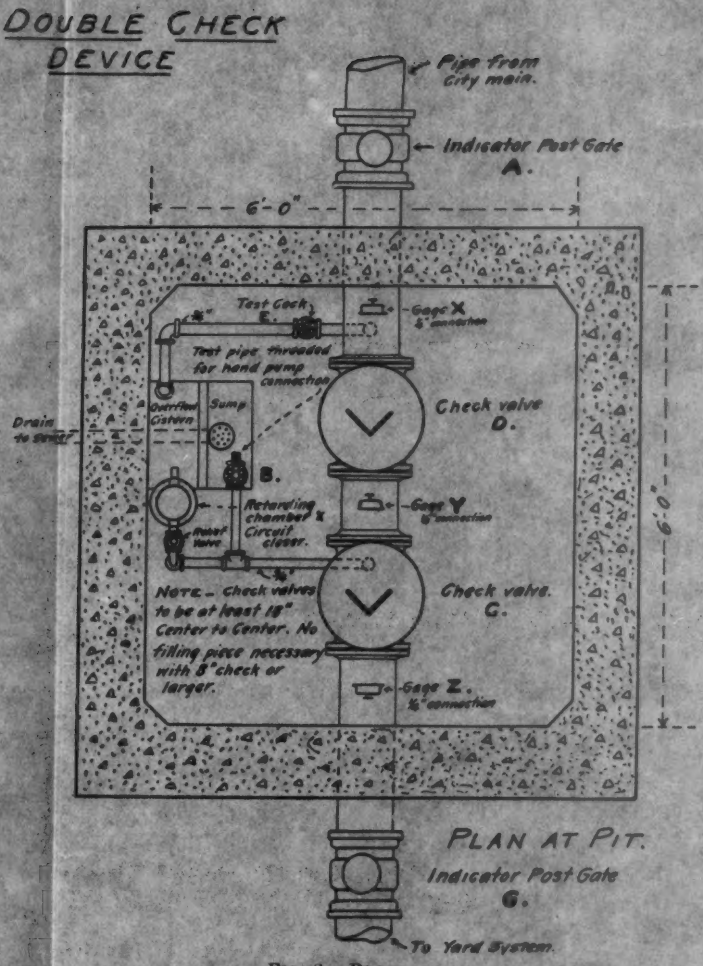


FIG. 2. PLAN.

BY THE HARTFORD WATER WORKS.

little unevennesses on the face, but by turning the rubber off, we thought we could make it tight, yet it still leaked quite a little on low pressures. We then went to work and rounded the face of the brass seat of the check, and that allowed it to crowd into the rubber more, giving a perfect seat, so that at pressures under 10 pounds the check was tight. The check was made with a large clearance around the disk, and the side plugs which support the arm or the hinge, as some manufacturers call it, was made to

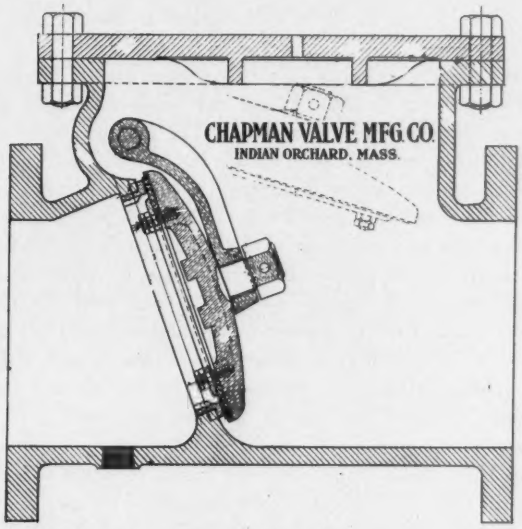


FIG. 1.
RECENT DESIGN FOR A CHECK VALVE, APPROVED BY THE FIRE UNDERWRITERS.

project into the check at least 0.25 in. beyond the iron, so that there was no chance for tubercles to form, or for corrosion to effect the working of the disk. The arm was made of solid bronze instead of the malleable iron or wrought iron or steel arm in general use in standard commercial checks. The disk itself was made of iron, with a cast-iron plate holding the rubber disk in place. It was found on examining the checks in some localities

that corrosion had taken place, and all over the rubber seat there were deposits of rust, which were liable to cause the check to leak. The design was then changed, so that the disk is now made of solid bronze, and the holding plate is also bronze, so that, as now built, all the inside working parts are bronze, and the danger from corrosion is eliminated.

Fig. 1 shows a recent design of a check-valve, approved by the fire underwriters.

MR. GEORGE A. STACY.* I do not think our conditions in Marlboro would exactly cover this subject in the form of danger from pollution.

We have quite a number of check-valves, under pressure from 15 or 20 pounds up to 180. In our city we depend upon hydrant pressure entirely for our fire service. The city is rather uneven. The distributing reservoir is virtually in the city, and on the distributing mains for domestic supply the pressure varies from 14 pounds to 142. In the higher levels of the city, where some of the largest factories and buildings are, we have only 30 pounds. In passing from the old hand-engine protection to water works, we abandoned the use of engines entirely. About 1894 the insurance people, on account of the growth of the factories and the increase in the size of the buildings in other parts of this district, demanded either a higher pressure or steamers. The matter was taken up by the chief engineer and myself, and we submitted it to a committee appointed by the city, and it was decided to put in a standpipe with three miles of independent mains to cover this district. Previous to the introduction of the standpipe we had introduced in every factory two sources of supply from different sections of the pipe line, so that if one section broke we could cut it off and still have a supply for the factory. When the high service, as we call it, was introduced, they requested that it should be connected with the sprinkler systems in that district, and here was a problem for us to meet. They wanted both supplies on at the same time, the one with 85 pounds pressure and the other with 30. In doing this we put a check-valve on the low-pressure supply in a manhole outside the factory (with an arrangement to test the check). The idea was to have them automatic, so if the high service was shut

* Superintendent of Water Works, Marlboro, Mass.

off the low service would supply the factory. That was introduced in 1896.

The distributing reservoir is on Mount Sligo, and immediately at the south end of the reservoir is the standpipe on a trestle 75 feet high. The two distributing mains leave the reservoir grounds within 20 feet of each other, and at that point there is a cross-over pipe connecting the two together, for the reason that we wanted these three miles of main to be available for fire protection (by being supplied from the reservoir), supposing anything should happen to the standpipe, or that the pump should fail. I will say there is a pump there of a million and a half gallons connected with this high service, pumping directly to the standpipe and its distributing mains. In that cross-over pipe was a check with a gate valve on each side. In all our experience we haven't found a leaky check-valve yet, although they have been tested many times. The inspectors shut off the high service, and then the low service, so the check-valves are open more or less.

When we clean and paint the standpipe we shut the valve at the bottom of the standpipe, after emptying it, then if we have a fire, the fire pump or reservoir supplies what water is used, and the check-valve or the cross-over pipe is opened and closed more or less.

In the factories, from the closest tests we have made of them, we haven't found a leaky check-valve up to the present time. These check-valves are of metal, seats and valves scraped in, made to special order. We have on the Worthington pump force main under 180 pounds pressure, a 16-inch check-valve, with four leaves in the valve, and that is absolutely tight. I have one check on the force main of the Blake engine that has leather faced valves, that has proved to be tight; but it has had to be renewed a number of times.

We haven't got at stake what the other people have, where the pumps are connected with polluted supplies; and notwithstanding the success that we have had with check-valves, if it were possible that a polluted supply of water was on the other side of a check-valve, I don't think I should feel very easy about it, even with all my experience, with the present type of valve, which I believe is the best that can be made, for clear water. I know very well it

wouldn't take but a very little to make one of these valves leak. But so far we have been very fortunate in the matter.

In listening to the experience of others, and from what I know of the mechanical construction of valves, and from what I have learned from my experience and work in that direction, I think it resolves itself pretty near to this: So far as check-valves are concerned in protecting your water supply from pollution, where there is a polluted supply on the other side, it is a good deal like the answer that was given in this Association a good many years ago by an old water-works superintendent, who had been all his life in the business and had a vast experience. We had been discussing how to keep water pipes from freezing in the winter, and we had heard all sorts of experiences, and at last we asked him for his experience, and what he thought was the best method to keep water pipes from freezing. That was during a time when we had been having some very severe cold weather. He said, "In my experience I have tried a good many things, all I could hear of and all I could think of, and I don't know of but two methods, — either put them below the frost, or keep the water out of them."

Mr. Edward V. French.* *Mr. President and Gentlemen,* — When I met the president this noon, he suggested that somebody was wanted to speak for the other side, and as he knew I was used to taking that position he said he would like to hear from me to-day, this being in line with a little previous warning. I think I have quite a task before me to bring out the other side of this question. I got a little anxious while Mr. Sullivan was talking, in spite of the kind remarks he made. It seems to me he has put the thing on the right basis when he tells us that this is a question of divorce. I think the "divorce evil" has gone on to a pretty serious extent already, and it may be that in this matter we ought to take some steps to check it.

There are two sides to most any question, and it is desirable, as the president said when he asked me to take a little interest in this, to have both sides brought out. We may well consider that there are two functions, at least, of a public water supply, and I agree, as Mr. Lochridge has stated, that the most important one is the furnishing of pure water. But there are other functions,

* Vice-President and Engineer, Arkwright Mutual Fire Insurance Company.

and I think nobody here will disagree when I say that an important function is the extinguishing of fire. It is for that reason that water systems are arranged with high pressures, following in the best practice what Springfield has recently done, and furnishing pressures that will give excellent fire streams all over the city. Large mains are then provided so we not only get good pressure but the pressure can be maintained with a large draft of water. Now, there is no use in doing this and then cutting off the largest benefit that can be obtained from fire service, if there is any reasonable way of avoiding it. It is on that side that I should like to speak for a little and attempt to bring out a few points.

I think there is no one of us who would not feel that the arrangement of fire services must be made so that the danger of polluting the drinking water supply is practically eliminated. In taking the matter up in a good many cases with the mills having such protection, they have all, in every case, agreed that as good citizens that was their first duty. The fact that conditions which have been so well described to-day exist in some places is easily explained. It is not a great many years ago when the city of Lowell, as Mr. Sullivan told us, was taking its water supply from that same river, and there was then little impropriety in having the fire pumps draw from the same water which the city was taking. Our changing views as to the need of pure water, which have been quite recent, comparatively, have brought about the criticising of these older arrangements, which have not been changed, perhaps, as rapidly as our ideas as to the need of pure water have changed. So we may consider, first, whether there is not some easy and reasonable means of overcoming this danger, in a way that will practically eliminate it.

We may first consider, then, what the danger really is. The ordinary fire system supplies automatic sprinklers and private hydrants, and the public water is connected to it, maintaining pressure on all this apparatus all the time. The automatic sprinkler system, in order to do its work, must have a good pressure on it, with pipes of such size that, when the sprinklers open, every sprinkler that opens, be it two sprinklers or fifty, will get an ample supply of water. Then a secondary supply is usually necessary for two reasons: the first, to give *additional* water when a large

fire occurs. A supply from the public mains with, say, 700 to 1 000 gallons a minute, delivered at good pressure, is a very good *primary* water supply for average conditions: but if a large mill gets well on fire, this is not at all enough water to cope with such a fire, and then an additional supply must come in. When a fire opens a great many sprinklers, it is necessary to put the additional water into those sprinklers and not depend exclusively on fire streams for fighting the fire. In order to do that, fire pumps are usually provided, taking water from some available source and discharging into the sprinklers and private hydrants, and supplementing the public supply, so that the sum of the waters available from the public source and the private pumps is ample to cope with any fire likely to occur.

In a great many places the public supply cannot give water enough. Mr. Lochridge has cited Springfield, and Springfield, perhaps, has almost the best — possibly the best — water supply for a city of its size in this country, not only in its quality, but in pressure and capacity; and the conditions there are ideal. They never can be reached in many of our cities. So that while in Springfield the secondary supply required may be much less in quantity than in other places, it is nevertheless likely to be needed and this does not relieve us in the other places from the necessity of a large and liberal secondary supply. It has in a number of cases, with public supplies of ordinary capacity, happened that steam fire engines and hose streams drawing from the town or city water have drawn down the pressure in the street mains so that there was little or no water available for automatic sprinklers. In such cases there is need of a good secondary supply inside of the yard check-valves for the automatic sprinklers.

The second reason for our secondary water supply is for duplication of service, — not only to get more water but to get two strings to our bow, so to speak, so if one source of water supply fails the other one will be available. As our water-works systems improve, as our public systems are strengthened, the chances of breakdowns become less; but, as Mr. Lochridge has intimated, it was only a few months ago that Springfield, just before its new supply was turned on, was practically without water for two or three days in some sections. That is a condition which is not

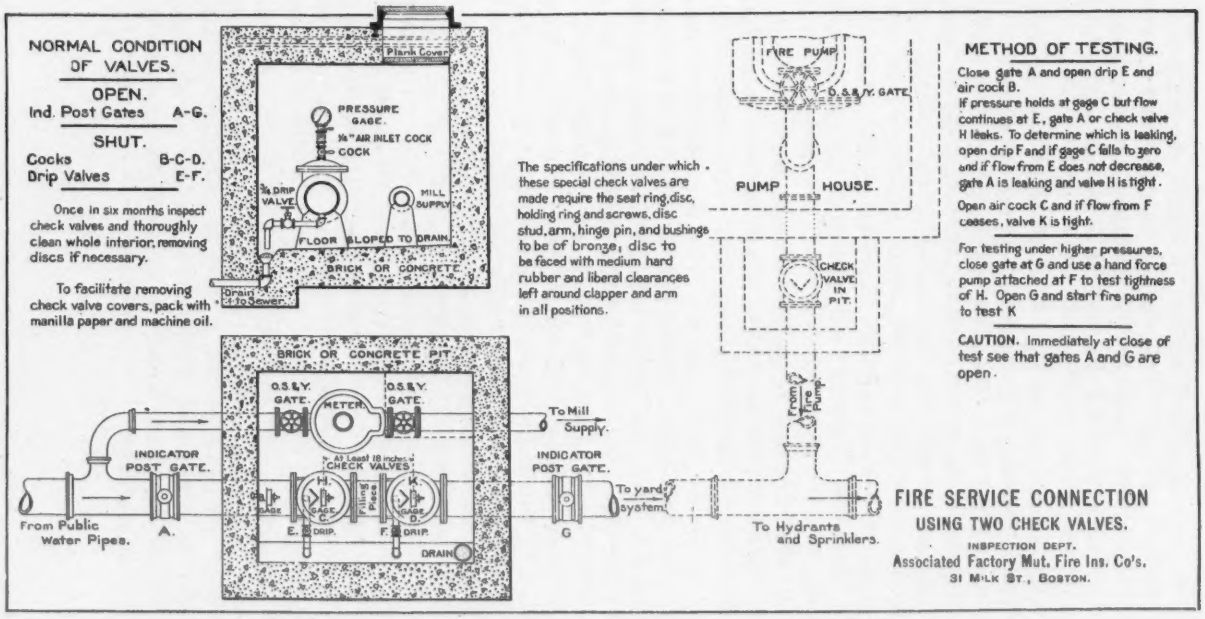

NORMAL CONDITION OF VALVES.
OPEN.
Ind. Post Gates A-G.
SHUT.
Cocks B-C-D.
Drip Valves E-F.
Once in six months inspect check valves and thoroughly clean whole interior, removing discs if necessary.
To facilitate removing check valve covers, pack with manilla paper and machine oil.
Plank Cover
PRESSURE GAGE.
½" AIR INLET COCK
COCK
½ DRIP VALVE
MILL SUPPLY
FLOOR SLOPED TO DRAIN
BRICK OR CONCRETE
Drain 4" to 8" Sewer
BRICK OR CONCRETE PIT
O.S.&Y. GATE.
METER
O.S.&Y. GATE.
To Mill Supply.
INDICATOR POST GATE.
At Least 18 inches
CHECK VALVES
H.
K.
GAGE C.
GAGE D.
Gate
Piping Plan
E. DRIP.
F. DRIP.
DRAIN
From Public Water Pipes.
A.
INDICATOR POST GATE.
G
To yard system.
The specifications under which these special check valves are made require the seat ring, disc, holding ring and screws, disc stud, arm, hinge pin, and bushings to be of bronze; disc to be faced with medium hard rubber and liberal clearances left around clapper and arm in all positions.
FIRE PUMP
O.S.&Y. GATE
PUMP HOUSE.
CHECK VALVE IN PIT.
From Fire Pump
To Hydrants and Sprinklers.
METHOD OF TESTING.
Close gate A and open drip E and air cock B.
If pressure holds at gage C but flow continues at E, gate A or check valve H leaks. To determine which is leaking, open drip F and if gage C falls to zero and if flow from E does not decrease, gate A is leaking and valve H is tight.
Open air cock C and if flow from F ceases, valve K is tight.
For testing under higher pressures, close gate at G and use a hand force pump attached at F to test tightness of H. Open G and start fire pump to test K
CAUTION. Immediately at close of test see that gates A and G are open.
FIRE SERVICE CONNECTION
USING TWO CHECK VALVES.
INSPECTION DEPT.
Associated Factory Mut. Fire Ins. Co's.
31 Milk St., Boston.

FIG. 2.

likely to occur again in Springfield, probably never will, but it is a condition which may occur in some other city, and at such a time should a fire break out, our secondary water supplies are our only salvation, — the sole reliance to prevent a most serious loss from fire.

Then, again, there are the ordinary breaks, and occasional shutdowns for changes, making it, where very large risks are to be protected, and where the success and prosperity of the communities depend on these industries, necessary to have ample secondary supplies. So that while, in a few places like Springfield, the public water is likely to be ample for almost any need, those places are the great exceptions, and even in Springfield moderate secondary supplies will generally be provided for factories.

Now, as to what the dangers are in these cases. In the first place, in the well-arranged private system, the water would enter the yard through one or two connections, seldom more, to-day. Those connections can be provided, as has been suggested to-day, with double check-valves. Such check-valves are put in wells, and the plan is to have them frequently and carefully inspected. The older check-valves were usually buried in the ground, and, as has been stated, their location was sometimes forgotten. But it is not necessary, with our modern equipments, that they should be so placed. Check-valves can be put where they are accessible and they can be inspected and looked after and tested just as carefully as any other part of the apparatus is tested. And it is the intention of the underwriters to include the testing of such check-valves as a part of their regular inspection service, giving them just as careful supervision as the sprinkler valves, or the pump, or any other important part of the fire equipment. This can be supplemented by such supervision by the water department as Mr. Peck has explained.

The arrangement of these valves is shown in Fig. 2. They are placed 18 in. apart on centers and are located in a pit. The necessary drips and gages are provided to permit testing each valve separately for tightness as described in the notes. Several manufacturers are prepared to supply the special check-valves for use with this arrangement.

Ordinarily, and always preferably, the fire system is used for no other purpose than to fight fires, and the fire pump in a majority of factories is only run in case of fire and for occasional testing. So that, the only time when there is pressure against the check-valve is either during a fire, when the fire pump is running, or during the occasional tests.

The testing work can be arranged, as has also been outlined at Holyoke, by first testing the pump, closing the valve on the city connection before the test commences; then open the valve and test the hydrants and blow out any river water that has been forced into the system by the fire pump. Then the inspector makes sure that he leaves the valves open, and the chance of trouble is practically nothing. It can also be arranged, where necessary and proper, to keep the discharge valve on the fire pump itself closed, and sealed, with the understanding that the breaking of the seal must be explained to the water department, the seal to be broken only in case of fire or by permission from the water department.

In all these ways we bring it to about this: That the only time, practically, that the check-valve in the service from the city needs to be subject to pressure against it higher than the city pressure, and, therefore, the only time when the public water is at all subjected to danger of pollution should the check leak, is the time of fire. In a protected manufacturing plant or mercantile building, fires requiring the use of the pump are infrequent, and if, therefore, we reduce the periods when that danger can exist to a very small number, and if, then, we guard those periods by a carefully arranged system of two check-valves, made as has been described, inspected as I have stated, we reduce the chance of trouble to an extremely small point. With reasonable supervision, and with good coöperation between the fire protection engineer and the water-works man, the possibility of trouble is reduced to a much smaller point than many other chances of pollution existing in the average water-works system.

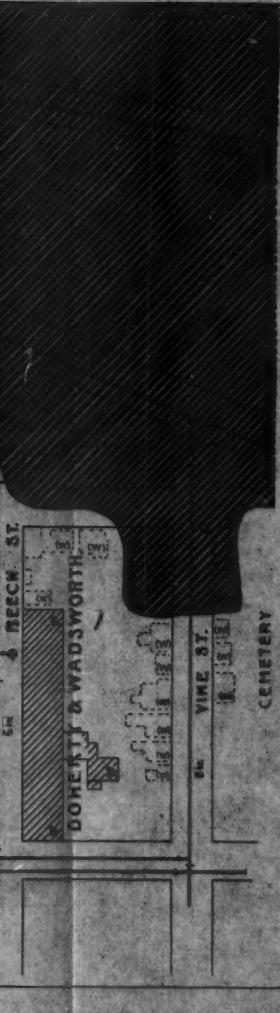
We are very apt, all of us, in looking over this problem, to over-estimate the danger, and because these cases from the past, with arrangements that are not up to date and do not represent the best practice, have here and there given trouble, to condemn

the whole thing. But this is the other side, which, as I say, it is my mission to try to bring to you.

Now, a word as to the value of these supplies. It may be brought up that the secondary supply is not often needed. But take the case of the conflagration at Paterson, N. J., some years ago. The city had a very good water supply and very fair pressure. The fire came down toward half a dozen silk mills. This was the second fire, Paterson having practically two fires, one starting from the other. The public fire department had exhausted about all its energies, and when the fire approached these silk mills there was only one steamer available for a long line of defense. The mills got out their fire streams, started their pumps, taking water from their cisterns, supplemented by what water might flow in from the public mains, and fought the fire as it came towards them, wetting down the houses that were burning, putting out the fires on the roofs from sparks, which deluged the mills like a summer shower, and when the fire was over a map of Paterson (Plate II) showed a long line where the black destruction stopped right parallel with those mills and nearly up to them. That is, those mills stopped that fire. They not only saved themselves, but they saved a large section of Paterson beyond. Now there was a case in a city where the secondary water supply saved millions of dollars.

Take another fire. The Cocheco Mill at Dover, N. H., burned. The public water there was of very good pressure and quantity. The mill was a large one. The weather was extremely cold. The fire started in the early morning and got away, due to the fact that the sprinklers were shut off at the time for some repairs, and it became a long fight. Fire pumps were started, three or four of them, and help was called from outside. The fire was finally extinguished and a large part of the mill buildings were saved. We made in that case a careful estimate of the amount of water used and found the total amount of water from Saturday morning, when the fire started, until Monday afternoon, when it was out, discharged on to the fire was about 8 000 000 gallons. Part of it came from the city, but the larger part from the factory fire pumps. Had the pumps taken their water from a limited source, the water supply would have failed absolutely before the fire was under

PARK ST. 6in.
Second Fire Started 100 E. north of this point.
MARKETS ST.
RAMAPO AVE.
ERIE R.R.
A.
B.
PARAGON SILK CO.
CREWS SILK Dye Works
MORTON ST.
STRAIGHT
DANFORD BROS. MFG. CO.
MADISON
THE WM. STRANGE CO.
BEECH ST.
EST. OF BEN. EASTWOOD
J. ROYLE & SONS
ESSEX ST.
12 in.
6in.



SKETCH SHOWING PART OF BURNED AREA NEAREST MUTUAL RISKS. FIRE IN PATERSON NEW JERSEY. On Feb. 7, 1902.

0 100 200 300 Ft.

NOTE — Burned District shown thus
Mutual Risks
City Water Pipes
Hydrants
Ordinary Pressure, Gravity, 35 Lbs.
Brick buildings shown with B.
Wood buildings " " W.

PARAGON SILK CO.
Worthington Duplex Pump 14×7×10. Suction from Two 20000 Gal. Cisterns and City Water.

EST. OF BEN. EASTWOOD.
500 Gal. Worthington Underwriter Pump. Suction from 75000 Gal. Cistern and Driven Well.

BAMFORD BROS. MFG. CO.
500 Gal. Worthington Underwriter Pump. Suction from 30000 Gal. Cistern.

THE WM. STRANGE CO.
1000 Gal. Worthington Underwriter Pump & 14×7×12 Worthington Pump Suction from 100000 Gal. Cistern, Driven Well and 3 inch pipe from City Main.

DOHERTY & WADSWORTH.
750 Gal. Worthington Underwriter Pump. Suction from 50000 Gal. Cistern fed from City Main through 4 in. meter.

J. ROYLE & SONS.
500 Gal. Worthington Underwriter Pump. Suction from 50000 Gal. Cistern.

control, and the mill would probably have been totally destroyed. So there was another actual case where the secondary supply saved the day.

There are many other cases of a similar kind, but two or three are just as good as more. The secondary supply, like any other reserve, does not come into use very often, but it is a thing that, when you do need it, like the Kentucky man's pistol, you need it mighty bad, and if you don't have it great destruction may result.

You cannot get at present in most cases any other supply for fire pumps as liberal as the ponds and rivers from which these pumps frequently draw. You can build a cistern holding an hour's or two hours' or three hours' supply, but that will not take the place of the unlimited supply from a pond or a river. So that the minute the practice comes to this, that it is absolutely necessary to forbid the drawing of such waters through fire pumps, under any sort of restrictions, just that minute your protection is reduced in efficiency, and in many cases very materially reduced; and, further than that, the cost is very largely increased. A plant worth five hundred thousand or a million dollars, or even a larger amount, cannot afford to take chances of having its business taken away or even seriously interrupted by fire due to inefficient or inadequate protection.

Now, we have on the one hand the practical question of fire protection engineering; we have on the other hand the health question; the two need not conflict. Isn't it possible that the very largest use of our public water systems, and the greatest benefit from them, can be secured by putting our energies into the perfecting of the double-check method as it stands, or of developing even better apparatus? Is it not possible that the water-supply engineer can thus find a way to still make his water supply of the greatest value for fire protection, while fully protecting it by insisting on the most complete and efficient but not prohibitive safeguards? If that can be done, it means that we retain the broad benefits which come from public water supplies of good pressure and large capacity. If it cannot be done, if we are not willing to look at that side of it, but take the easier method of cutting off the water supply entirely, without having patience to study it, then we cut off from our water-supply systems a very large function and

a very valuable work which they are capable of doing. It is to be hoped that our ingenuity and our patience and our desire to look at this problem broadly will enable us to work out these safeguards together until we can combine the two main functions of water supplies in a safe and reasonable way. And it is upon that side of it, knowing that what has been done looks very satisfactory and promising, as Mr. Peck has stated to us, that I want to appeal for the broader view of this problem. We should not throw away all these possibilities; any one can say that absolute separation is certainly safe, but we ought to use our full energies and all the power of our minds and our ingenuity to perfect these safeguards which in very many cases, at least for many years to come, can reduce this danger to a point that is negligible.

MR. LOCHRIDGE. I want to take issue with some statements that Mr. French has made, and to say that I agree with him in some of the others. I believe thoroughly in the protection of the mill or of any property. I believe that the function of a water supply is, first, the furnishing of a pure water to all the people all the time; and, second, and just inferior to the first, the furnishing of an adequate fire supply.

Springfield isn't different from other cities, except that we have our supply substantially completed. If you go through the list of cities represented here, they are all on the up grade, they are all striving for a supply which will give very much more efficient fire service. To-day we are laying mains — and as a rule all the cities are laying larger mains — not sufficient simply to secure drinking water, but to secure adequate fire protection.

If we must have the second supply, what we want is something that is safe. I am willing to grant that the double-check system is a great improvement, and I am willing to grant that in many cases it may be practically safe. *Practically* safe is a good stepping stone. In the study of a great many fire risks that are controlled by the various insurance companies, you will find that many of them could be taken care of by an independent system at a small cost. I have run over the cost of separating these systems and carrying the water directly to the tank or to the sprinklers, and also to the hydrants, and I have found out what it would be. We must remember that in most cases, and especially with us,

nothing whatever is charged for the water. By this additional system large reductions in insurance rates are secured above what can be secured by a single system. Now, doesn't it seem to follow that it would be reasonable in a great many cases to have that system an absolutely independent system, have it thoroughly equipped, thoroughly inspected, always ready, and have it in such a way that the additional cost is put where it belongs, on that particular risk which secures the benefit of the lower rates? I am not in any way depreciating the value of the double-check system, but it seems to me that insurance men in general will put in a check-valve because it is a simple thing, because it is the quickest way to get at it. A great many risks are not large enough for a separate pipe system from independent sources, and a capacity sufficient for three or five or a dozen hydrants in the yard would be prohibitive. Yet such an arrangement would add an additional safety in the many cases where it is possible by providing a second complete system directly within their own walls and directly within their own property. In a number of the cases I studied, I found that the piping could be so carried that it could handle all of the sprinklers, with independent hydrants in the yard, where the city water could also be used, and in that way, while it might not carry all of them, it might be a great help.

I feel that the risks should make the departments recognize their responsibility, and meet them in such a way that, where it is possible to do such a thing, it can be done. It is not always necessary to change the whole system inside the mill. When you duplicate it, it does not mean that all the pipes must be duplicated. The sprinkler system can have a single pipe and have it furnished in the same way, and the secondary furnished from a tank, as in over fifty out of our sixty risks in Springfield.

In the cities where the lower pressure obtains, you should have your check even more absolute, because every time the pressure is raised you have the added danger of leaking in the check, or whatever the device is, which we would not have with the higher pressure.

I want to tell a little incident that happened on our system. We were greatly impressed with the insurance men's argument that the thing to do was to have some one ready to be the first

man on the spot when a fire starts; and in one of our largest establishments that is supplied with a check we put in a second check and a positive valve. One man, who was always on duty, was to have as his first duty, in case of fire, the closing of that valve against our system. After the first fire one of the engineers went out from our office, and he said, " Did you shut the valve as agreed? " "O, Lord! I never thought of it."

MR. SULLIVAN. I have been interested in the remarks of Mr. French and of Mr. Lochridge. There was one point Mr. French brought out. That was, Fire Service *versus* Sanitation. I want to say a few words on the hazard of inspecting and testing fire services. The mills usually supply drinking water to the operatives from the fire pipes, such water at most times being city water. The inspectors have the fire pumps started, and pump water from the secondary supply into the fire pipes, generally during working hours. Such supply, in most cases, is a polluted supply. The employees of the mills and factories, if they want a drink while the testing is going on, or before the water is drawn off in the manner described by Mr. Kirkpatrick, get a chance to drink contaminated water. And I know that, in one place where I have been, the typhoid fever cases reported were tabulated and charted, and it was found that a very large percentage of the cases were found to be operatives who had access to the so-called canal water during working hours. We were almost certain that the city supply was safe, and it was certain that the operatives had not arrived at the delightful stage of civilization when they could go abroad or on vacations and contract typhoid at any of the watering places, and one of the conclusions we arrived at was, that when fire pumps were tested, the operatives got a dose of polluted water. Operatives drank the water in preference to waiting until it cleared up, as the custom was not to draw off the polluted water supply. In fact, many operatives knew nothing about the testing, or, in many cases, would not realize the danger if they did.

There have been, in most cases, absolutely no precautions taken to prevent operatives drinking the water during and following a fire test. I would like to ask Mr. Kirkpatrick what is done in case of fire at night-time; is the positive acting gate closed?

MR. KIRKPATRICK. Mr. President, it is—provided the hydrant

man gets there before they turn the pump on. We have a hydrant man who answers every fire alarm, and if he happens to get there before the fire department, he closes the gate valve, providing the pump is in operation; otherwise he does not.

With regard to the other point Mr. Sullivan made, I think such cases as he has spoken of might be obviated by compelling the mills and factories to have independent services for drinking purposes only. There was a time in the city of Holyoke when mill operatives were allowed to use the canal water, for the pipes were all connected, as Mr. Sullivan stated. The local board of health and the water commissioners have ordered that practice abandoned, and the mills now have separate services to supply them with drinking water from the city mains.

MR. M. F. COLLINS.* Check-valves do not seem to have any friends here this afternoon, so I guess a little more knocking won't do them any particular harm. In one of our mills in Lawrence in 1904 we had an epidemic of typhoid fever. We went to work and traced it out and found in the neighborhood of 36 or 40 cases in that one mill. The epidemic became so serious that we called the attention of the State Board of Health to it, and they had one of their employees at our local experimental station make a test of the water. He tested the water right around the check-valve which was there, and found the condition of the water was just about the same as it was in the Merrimac River before being filtered. The city of Lawrence has gone to the expense of purifying its water in order to give the people a pure water to drink. So, after finding out what the trouble was, we called the attention of the agent of the mill to it and asked him to put in an extra check-valve, which he did, and since that time we have had no trouble at all.

It is my opinion that check-valves as a rule are very uncertain quantities and not to be relied upon at any time, as far as being absolutely tight is concerned. There are two or three ways of looking at the check-valve. Mr. French says the only danger that he apprehended was when the fire pumps were being tested. In our mills the fire pumps are going twenty-four hours every day; they are not shut down at all. In the neighborhood of one of our mills, where there was a check-valve, we had considerable trouble

* Superintendent of Water Works, Lawrence, Mass.

and complaint about rusty water at one time. I saw the managers of the mill and they told me they didn't use any of our city water. I had a recording gage put in my office, and every time there was a complaint from that neighborhood I looked at my gage and I would find that there was quite a quantity of water being used, lowering the pressure on the gage. One morning I got a complaint of rusty water, and looking at the gage I found the pressure had lowered. It was then about eight o'clock. I drove right up to the mill and called out the master mechanic and asked him if they had been using our city water. He said no. I told him to go inside and find out whether they had or not, for I was sure they had, so he went in, saw the man who operated the fire pumps, and found that something had happened to the pump, and it had been shut down, he said, for between ten and fifteen minutes. The minute that pump shut down, — they have a pressure there right along of about 90 to 100 pounds against 65 on our mains,— our water ran into the mains in the mill; consequently, when they started up their pump there was a chance that some of that water would get into our mains. So I think that if the underwriters would get together and devise some means by which both systems could be separated, it would be a good thing.

PROF. EDWARD W. BEMIS.* In Cleveland last year I began to take up this subject, and found such a condition as Mr. Collins has described, where the pressure from the fire pumps, that were running a great deal of the time, was very much greater than the pressure on our mains, and apparently there was no reliance to be placed on the check-valves. Finally an arrangement was entered into, and the Board of Public Services approved of it, for the absolute separation of the supplies, so that the pipes carrying our water would not carry any polluted water. They can have as many supplies in a factory as they wish, but there must be no connection between the two piping systems. That requirement is now gradually being put into effect, I understand, in Cleveland, and unless there can be a more efficient invention for a check-valve than seems to be yet before us, — something not yet apparently on the market, — I believe the time is coming when that requirement will be the universal practice. It is possible, as

* Deputy Water Commissioner, Water Supply, Gas, and Electricity, New York City.

Mr. Lochridge says, or it may be possible, to allow some of the piping, some of the sprinkler system, to be connected with both supplies, but most of the systems will have to be separated. I noticed in the two illustrations that Mr. French gave of the very great importance of the secondary supplies, that the secondary supplies were used apparently through hose and hydrants, or from risers, and that would be, of course, allowed even if there were a separation of the piping. The requirement of a separation of the piping would not have prevented the use of that supply in either of those two cases, or in most of the other cases. It strikes me that the city supply ought always to be sufficient to take care of the sprinkler system, and, if the factories desire, of course they can have a tank on the roof, or some further storage on that supply; and that the independent supply in fire mains, in hydrants, in risers with hose attachments, etc., could be absolutely independent, and still nearly as effective as now,— perhaps not quite, but nearly so. I believe we are coming to that universally, unless inventors get busy and do something that they haven't done yet for us.

MR. FRENCH. Regarding what Professor Bemis has just said, it is true that at Paterson the protection was through hose streams. At the Cocheco Mills the fact that four or five pumps were immediately thrown on to the sprinklers, when several hundred sprinklers were opened, was a very large factor in checking the fire, and had it not been possible to put those pumps on at once I believe the fire would have been much more serious. The two cases fall, one in one class and the other in the other.

Now, regarding what Mr. Collins states, it is true that in several of the older mills of Lowell and Lawrence and some other places it is the practice to maintain the pump pressure during the day and sometimes at night against the city water; but those cases are the exceptions. I think in most places it would be entirely feasible and in every way desirable to make a complete separation between the pipes carrying water for drinking purposes and those carrying water from the river supply for toilets, boiler feeding, and such purposes, where cheaper water is desired. That would answer the point that Mr. Collins made. We do not believe it is proper to take water from the fire system, or from pipes connected

with the fire system in a mill, for drinking purposes, and a great many have already changed to an entirely separate drinking water system. I merely mention these things because they are points that, while a natural part of this discussion, are in no way an essential part of the settlement of the problem. The problem can be made a very clean, straight problem of a fire system used exclusively for fires, into which at rare occasions it is desired to pump water from an unlimited source like a river or a pond which may be polluted. In all those cases where drinking water is taken from the mill supplies, it is reasonable to insist that such uses be cut off entirely from the fire system.

A word as to what Mr. Lochridge said as to the possibility of two supplies. It is not possible to supply the sprinklers from one set of pipes and the hydrants from another set of pipes, and still have the secondary fire supply from the pumps on the sprinklers as well as the city water, unless you have the two systems together at times, and depend on some form of check-valve. Any double system of that nature — and we have put in many such — are likely to develop complications which, entirely beyond the question of cost, may be serious in case of fire.

MR. J. H. CHILD. Mr. President, I should like to ask if the insurance interests are doing anything of their own volition in placing double checks, or doing anything along this line, or if it has not been the result of agitation from the water-works men.

MR. FRENCH. Mr. President, I will answer that very gladly. The insurance interests are taking steps from their own experience, and to-day in practically every layout made in our association, where there is a possibility of pollution, a double check is included. We have spent a great deal of time and money in the development of the double check, and in the study of other and possibly better arrangements. I think if I could show you the whole history of what the underwriters have done, you would feel that they had certainly done a very large amount of work on this subject.

MR. CHILD. I was speaking from my own experience, and with a system recently laid out, where I have seen no indication of a double check, and certainly the secondary system is decidedly polluted.

MR. FRENCH. I don't know the case, but I should be very glad to look at it with you.

MR. SULLIVAN. The fairness of the insurance people was shown in a case when they compromised with us, devoting considerable time in getting up some special devices. I think we ought to give the insurance people a little credit.

MR. J. WALTER ACKERMAN (*by letter*).* The city of Auburn, N. Y., a town of about 36 000 inhabitants, is situated in the central New York lake district, on the outlet of Owasco Lake. This lake has a drainage area of about two hundred square miles, and the topography of the city is such that there is about two hundred feet of fall in the outlet of the lake as it passes through the city, so that it furnishes a great deal of water power, and naturally many mills and factories were located on this stream during the development of the town. In fact, Auburn is classed as a manufacturing city.

In the spring of 1908, there was a small epidemic of typhoid fever. The water commissioners employed a sanitary expert to see if the source of it could be discovered, but his report, rendered some months later, which showed evidence of very careful research, did not show any positive proof of the source of the epidemic. However, on account of the fact that no other carrier was as common as the water supply, the probable cause of this epidemic was finally laid to the city supply. Further investigation by other sanitary experts failed to add any further information, and corroborated the first expert's opinion. Prior to the outbreak there had been several cases of fever on the watershed, but they were isolated from all streams and from each other, so that it did not seem probable that the epidemic came from them, and hence it was thought it must have come from some other accidental pollution.

The writer assumed the duties of superintendent of the Auburn water works in September of the same year, but was thoroughly familiar with the situation, as he had served in the capacity of city engineer for a period of six years. After being in office for a short time, it was learned that some of the men in the factories complained that they did not like the drinking water after a fire-

* Superintendent of Water Works, Auburn, N. Y.

drill. This lead to an investigation regarding the check-valves in different factories of the city, relative to whether they were working properly or not. However, in fairness to the above incident, I will say that the water which the factory operatives objected to did not come from a polluted source, as it was a tank supply coming directly from the city mains, but of course, standing there for long periods of time, without change, it became very unpalatable.

The municipal water supply of the city comes from Owasco Lake, being drawn at a point about 40 feet underneath the surface and about 2 000 feet from the foot of the lake. It is pumped from the lake directly into the suction pipe of the station, situated down in the city, through a 24-inch main about 9 000 feet in length. There is no intermediate reservoir or storage in any part of the system. The normal pressure carried on the city mains varies from 50 to 90 pounds, depending upon the locality. At all the mills and factories, I think the lowest pressure at any time is about 60, and perhaps increases to about 90, but at times of fire this pressure is increased by about 35 to 40 pounds.

In about a dozen of the factories, they have auxiliary fire-service equipment, of the following general type. In the street bordering the factory or mill site, the mains of the city distribution system, generally 12 inches in size, are located at a depth of about 5 feet underground; either at one or two points on this main, a connection is made from 4 to 12 inches in diameter, depending upon the amount of water needed for fire protection proportionate to the size of the factory. Most of the original installations, generally had an indicator post on the gate valve which closed the leader running into the factory, but which was used only at such times as repairs were being made, as the efficiency of the system depended upon this valve being open at all times for immediate use. After the water passed through the above-mentioned gate valve on its way to the factory, it next passed through a check-valve which was so placed as to allow the water to pass freely through it on the way to the factory, but which was supposed to close tightly if a current of water passed in the opposite direction back toward the city main.

When this examination of the check-valves was started, we

found that in general they were all buried underneath the ground and had never been inspected since being installed, and were left there without attention in the same way as the ordinary gate valve. However, some of the factories examined did have their check-valves in an accessible pit. After the water has passed through the check-valve on its way to the factory, it circulates through the yard system, which has on it several outside fire hydrants, and then into the building, and fills the automatic sprinkling pipes and the risers on which are attached the hose stands for use on the different floors of the factory. It should be noted in this connection that the city pressure is on all of the apparatus all of the time.

In order to comply with insurance requirements and to secure low insurance rates, the factory owner has to provide an auxiliary supply in addition to this system. This is accomplished by installing at some point in or adjacent to the factory a steam

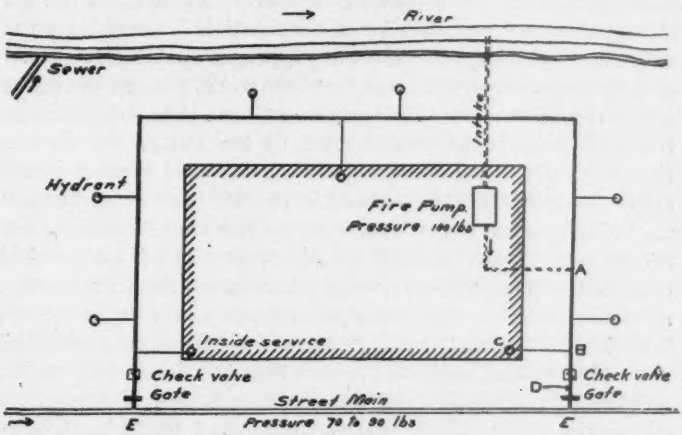


Diagram showing a Typical Arrangement of Connections for an Auxiliary Fire Supply in a mill in Auburn, N.Y.
(After J. W. Ackerman)

FIG. 3.

fire pump, or other similar apparatus, capable of pumping water at a high pressure. The supply for this pump in this city generally comes from the Owasco River, on account of the fact that most of the factories are located on or near it. This river, flowing through the center of the town, receives the discharges from many sewers nearly the whole length of its course through the city; consequently the water is nothing more or less than dilute sewage. The discharge from this pump is connected with the main supply from the city mains at some point in the factory yard, so that the polluted water from the river joins the city water after the city water has passed through the check-valve on its way to the factory. This constitutes the typical fire-protection scheme with auxiliary supply. Fig. 3 shows a general installation.

The method of operation, according to insurance regulation, was to the effect that the fire pump was to be operated at least once per week, to see that everything was in working order. On being present at these tests, the writer found that the pump, taking its supply from the river above mentioned, would bring the entire factory supply system up to the pressure at which the relief of the pump was set, which ran from 100 to 120 pounds, so that at a time of testing, all of the pipes and mains in the factory were at the same pressure as that created by the pump. At such a time, even if there were any fires in the city, this pressure would always be more than that carried in the city main, consequently the inside pressure would tend to go out into the city main, if the check valve did not properly operate to prevent it. At the time of an actual fire at a factory, or an actual test of the entire system, as conducted by the insurance inspectors, the entire system is filled with polluted water, because the fire pump maintains, generally speaking, a higher pressure than the city system carries, and the different hose connections in operation would soon empty the supply of city water stored in them, which would be replaced by the polluted water of the river.

In order to study the situation, the factory owners very willingly uncovered all of the check-valves, and taps were inserted into the pipe lines between the check-valve and the gate valve with the post indicator before mentioned. Then by varying the pressures inside the factory, it could be determined whether water came

back through the check and out of this tap; many samples of water were collected. Some of these check-valves seemed to close absolutely tight; generally speaking, however, the larger the check-valve, the greater the leaks — and in some instances they were notoriously bad. Bacterial examinations which were taken at this time showed polluted water going back through the check-valve toward the city main.

After these examinations were concluded, Mr. George C. Whipple, of the firm of Hazen & Whipple, who was making a complete sanitary report on the entire system, was asked to examine the check-valves and look over the examinations already made. The result of his report was such that the water commissioners felt that contamination was liable to result from the continuance of the installation, as then existing, and so all factory and mill connections were ordered discontinued if the auxiliary supply was to be used in connection thereto. This, of course, met with strenuous opposition on the part of the factory owners, and after they appealed to their insurance interest, the insurance people recommended double check-valves in the place of the single ones previously used. This concededly better equipment was not endorsed, however, by the water commissioners, but critical examination of these double check-valves showed that there were many chances of improvement in design, as tuberculation of corroding surfaces was liable to cause the same condition of affairs as was found in the single check-valves.

On a request by the insurance and factory interests for a further conference, which was given them by the water commissioners, the matter was turned over to the commissioners' experts, Hazen & Whipple, and the experts representing the fire insurance companies. As a result of this joint conference, the commissioners modified their original order of discontinuance of the fire connection, but adopted a special design of double check-valve submitted by the experts of the insurance people; and, as the situation now stands, these specially designed and constructed double check-valves are to be installed on all fire-service connections to be placed in brick or concrete pits that are accessible for inspection, the inspection to be made by agents of the water board, the factory owner to pay all such expenses, the normal inspection

being to test for leakage; but at least every six months the valves are to be dismantled and examined to see if there is any chance for further improvement in design, or if they are in any way actually faulty under the present form.

The only unfortunate incident at the present time is the fact that only one manufacturer could be induced to take up the construction of these special check-valves, and a change of management has also somewhat delayed delivery. However, the writer is informed that other manufacturers are now looking up the question, and we hope that before long the entire equipment will be in operation.

MR. A. E. HANSEN* (*by letter*). Assuming Mr. French's theory that only a slight amount of unsafe water can enter the city mains by way of the interposed check-valves to be correct, it seems that he condemns his own side by this concession, since even a slight amount of water may contain — and if the secondary supply is seriously contaminated, undoubtedly will contain — millions of intestinal bacteria, a goodly number of which under certain conditions will be of the typhoid type. The introduction of these bacteria directly into the water mains is of much more serious consequence than would be their introduction into the supply at the head waters; no chance even for sedimentation is given, but a direct delivery of the germs to the adjacent consumers is established with no possibility of their removal. The question, then should not be slighted, but must be faced as one deserving the most serious consideration.

The ordinance of the Cambridge, Mass., water department, prohibiting the connection of any outside supply to the city water mains, as brought out by Mr. Brooks, is, in my opinion, the only proper attitude for water-works engineers and superintendents to take, and even Mr. French concedes that the supply of pure water must be the first consideration which takes precedence over all others.

New York has a secondary supply of salt water for the fire protection of the tall buildings. Nobody would think for a minute of cross-connecting this to the primary supply of Croton water, and there appears to be no necessity of it. A good many of the taller

* Sanitary Engineer, New York City.

loft buildings have sprinkling devices for fire protection which are way above the elevation to which the Croton supply would rise. These buildings have sprinkler and standpipe systems entirely separate from the general water-supply system, except that they are supplied from a tank on the roof filled automatically by a pump with Croton water. This tank supply furnishes the first water to the sprinklers. A Siamese hose connection is provided in the sprinkler and standpipe system on the sidewalk for the hose attachment of the fire engine, which upon its arrival pumps from a nearby fire hydrant to the standpipes and sprinklers.

It should not be difficult or prohibitively expensive to apply a similar method to the fire protection system of mills using a secondary supply in the following manner:

Provide a storage tank of sufficient size and elevation to meet the requirements of the Board of Fire Underwriters for the purpose of supplying the automatic sprinklers during the first stages of a fire.

Provide an approved fire pump automatically connected to start as soon as the water level falls in the tank; cross-connect the pump discharge with the standpipe and sprinkler system direct, and connect the pump suction to the secondary supply. Provide a check-valve on the fire line just below the tank, and a standard fire department Siamese connection for fire engine just outside of building.

Install, further, a permanent suction line from the secondary supply to a point near the Siamese plug, and fit same also with a standard fire engine hose thread for hose suction connection to the fire engine. All water used in the inside standpipe and sprinkler system would, therefore, be supplied from the secondary supply, whereas any water from the fire department hose service might be obtained from either the city or from the secondary supply.

MR. FRENCH (*by letter*). It is evident that Mr. Hansen did not fully understand some of my statements. I did not agree for an instant that even a slight amount of unsafe water might enter the public mains, and I should certainly concur with him that under some conditions a small amount of polluted water might be a very serious danger.

The point is, that in a properly laid out system the only time when there would be a pressure against the check-valves in the service connection from the public mains higher than the pressure in the public mains would be during a severe fire, or occasional testing. In thoroughly protected risks severe fires are very rare, while all testing can be done in such a way that there is absolutely no possibility of getting polluted water into the public mains. Therefore, the periods during which trouble could possibly occur are infrequent and short and in many risks might not aggregate more than a few hours in ten or twenty years.

For these times we would have with the plans outlined two well-designed and well-cared-for check-valves, and the chances of both failing is in itself very remote. Again, during the possible severe fire the draft in the factory yard would be heavy so that the whole tendency is for the water to be flowing into the yard rather than out of it.

When, therefore, we couple all of these conditions together it is at once apparent that the chance of getting polluted water into the public mains is practically negligible and does not with any present light seem to justify the requirement of absolutely cutting off the public water from such fire systems.

The arrangement of supplies which Mr. Hansen suggests applies mainly to the city of New York and would not be applicable to the many manufacturing plants located throughout the country in small cities and towns, and very frequently almost entirely dependent upon their own equipment for heavy fire fighting. It will be recognized at once that a large percentage of our manufacturing properties are thus situated. In these cases, though the primary supply for sprinklers may come from public mains, the one, three, or possibly five thousand gallons per minute which might be needed at high pressure in case of a severe fire must come from their own fire pumps.

Again, it should be appreciated that while city buildings such as Mr. Hansen cites are practically always quite limited in area per floor, our great industrial development has required enormous areas in single buildings and to-day factories 150 feet in width, and 600 feet and even 800 feet in length, are not uncommon. In such plants under possible conditions a quick fire may open many

sprinklers, necessitating an ample primary water supply followed by most liberal reinforcing from fire pumps.

The plan which Mr. Hanson suggests would let the fire pump draw from an unlimited secondary supply, but in many cases where our primary supply is now furnished by a connection from public mains which give good pressure and ample quantity would compel giving up this good primary supply and substituting for it an elevated tank. In many instances no elevated tank possible would give the pressure or quantity of water which the public service gives, so that besides entailing considerable expense, this plan would result in materially weakening the efficiency of the protection.

Fire protection engineering has brought methods of preventing loss to a high state of efficiency and is making a decided stand to stop the enormous fire waste of this country. The best practice for large manufacturing plants has gone entirely beyond the limitations which Mr. Hansen suggests. It is therefore most desirable that this problem be very broadly considered, and certainly it is only reasonable to first see if experience will not show that along the lines of safeguarding suggested in the previous discussions it will not be found that there is ample protection against any danger of polluting our public supplies, and that with such protection we can continue to let public water be used for fire fighting work in the way which long study has shown permits its largest usefulness.

PROCEEDINGS.

PROVIDENCE, R. I., June 22, 1910.

The June meeting of the New England Water Works Association was held at Field's Point, Providence, on June 22, 1910.

The following members and guests were present:

MEMBERS.

J. H. Ayres, L. M. Bancroft, F. A. Barbour, A. E. Blackmer, G. A. P. Bucknam, T. J. Carmody, J. C. Chase, J. H. Child, C. E. Childs, R. C. P. Coggeshall, John Doyle, E. D. Eldredge, J. W. Ellis, A. N. French, F. L. Fuller, F. J. Gifford, C. W. Gilbert, F. H. Gunther, F. E. Hall, A. E. Hansen, F. T. Kemble, Willard Kent, G. A. King, A. R. McCallum, Thomas McKenzie, John Mayo, F. H. Mills, H. D. Pease, E. M. Peck, C. E. Peirce, J. J. Philbin, A. L. Sawyer, W. H. Sears, E. M. Shedd, G. H. Snell, G. T. Staples, W. M. Stone, H. L. Thomas, W. H. Thomas, D. N. Tower, C. H. Tuttle, G. E. Winslow, and I. S. Wood. — 43.

ASSOCIATES.

Harold L. Bond Company, by H. P. J. Earnshaw; Builders Iron Company, by F. N. Connet; Chapman Valve Manufacturing Company, by H. L. DeWolf and A. W. Hobbs; Darling Pump and Manufacturing Company (Ltd.), by H. H. Davis; Gamon Meter Company, by W. H. Buckley; International Steam Pump Company, by Samuel Harrison; Lead-Lined Iron Pipe Company, by T. E. Dwyer; Charles Millar & Son Company, by Charles F. Glavin; H. Mueller Manufacturing Company, by George A. Caldwell; National Meter Company, by J. G. Lufkin and H. L. Weston; Norwood Engineering Company, by H. W. Hosford and C. E. Childs; Ross Valve Manufacturing Company, by William Ross; A. P. Smith Manufacturing Company, by F. N. Whitcomb; Thomson Meter Company, by E. M. Shedd; Union Water Meter Company, by F. E. Hall, E. K. Otis, and E. P. King; United States Cast Iron Pipe and Foundry Company, by F. W. Nevins; Water Works Equipment Company, by H. M. Heim; R. D. Wood & Company, by W. F. Woodburn. — 23.

GUESTS.

Mr. E. S. Locke, Superintendent, Water Works, Lexington, Mass.; Fred. A. Hall, Inspector, Haverhill, Mass.; A. W. Dunbar, Hyde Park, Mass.; D. K. Bartlett, Whitman, Mass.; Mrs. I. G. Wood, Miss M. E. Wood, Wm. H. Patterson, O. F. Clapp, J. A. McKenna, J. E. Bowen, J. W. Bugbee, and F. P.

Gorham, Providence, R. I.; John J. Phelan, Worcester, Mass.; J. W. Wixtead, East Douglass, Mass.; William Fay, Worcester, Mass.; Mrs. George T. Staples, Dedham, Mass.; Mrs. H. W. Hosford, Florence, Mass.; Mrs. C. E. Peirce, East Providence, R. I.; F. O. Clapp, Asst. Engr., Providence, R. I.; Mrs. George E. Winslow, Waltham, Mass.; Mrs. T. J. Carmody, Mrs. J. J. White, Miss Alice S. Corner, Miss Catherine Sullivan, Holyoke, Mass.; Severance Burrage, Prof. Sanitary Science, Purdue University, Lafayette, Ind.; H. A. Seymour, Warren, R. I.; Mrs. Willard Kent, Narragansett Pier, R. I.; Mrs. John Mayo and Miss Sarah W. Mayo, Bridgewater, Mass.; Peter J. Cannan, Water Registrar, Clinton, Mass.; Mrs. Frank J. Gifford, Fall River, Mass., and Wm. R. Edwards, East Jersey Water Company, Paterson, N. J. — 32.

Upon recommendation of the Executive Committee the following-named applicants were elected to membership in the Association: Henry F. Bryant, engineer, Brookline, Mass.; Edward J. Looney, superintendent water works, Belmont, Mass.; Frank A. Sampson, superintendent water works, Kingston, Mass.; A. F. Sickman, hydraulic engineer, Holyoke Water Power Company, Holyoke, Mass.; Charles E. Ratz, superintendent Water Company, Punxsutawney, Pa.; Bernard M. Wagner, engineer, in charge of Construction Water Department, Rockville Center, L. I.; J. H. Bridges, superintendent water company, Henderson, N. C.; Wm. H. C. Ramsey, superintendent Citizens Light, Heating and Power Company, Johnstown, Pa.; William W. Seymour, Provident Building, Tacoma, Wash.; John A. Burgan, water commissioner, Hammonton, N. J.; Richard W. Rea, hydraulic engineer, Seattle, Washington; Fred C. Dunlap, chief engineer, Bureau of Water, Philadelphia, Pa.; George Holtzmann, superintendent water works, Schenectady, N. Y. — 13.

Adjourned.

WILLARD KENT, *Secretary.*

EXECUTIVE COMMITTEE.

JUNE 22, 1910.

A meeting of the Executive Committee was held on the steamer *Squantum*, en route to Field's Point, Providence, R. I., the occasion being the June Outing.

Present: President George A. King, and members Lewis M. Bancroft, Ermon M. Peck, and Williard Kent.

The following applications for membership were received and considered, and it was voted that all of said applicants be recommended for membership in the Association. Henry F. Byrant, engineer, Brookline, Mass.; Edward J. Looney, superintendent water works, Belmont, Mass.; Frank A. Sampson, superintendent water works, Kingston, Mass.; A. F. Sickman, hydraulic engineer, Holyoke Water Power Company, Holyoke, Mass.; Charles E. Ratz, superintendent water company, Punxsutawney, Pa.; Bernard M. Wagner, engineer in charge construction, Water Department, Rockville Center, L. I.; J. H. Bridges, superintendent water company, Henderson, N. C.; Wm. H. C. Ramsey, superintendent Citizens Light, Heating, and Power Company, Johnstown, Pa.; William W. Seymour, Provident Building, Tacoma, Wash.; John A. Burgan, water commissioner, Hammonton, N. J.; Richard W. Rea, hydraulic engineer, Seattle, Wash.; Fred C. Dunlap, chief engineer, Bureau of Water, Philadelphia, Pa.; George Holtzmann, superintendent water works, Schenectady, N. Y. — 13.

The matter of the expense incurred by the Committee on Uniform Accounting was considered and it was voted that bill for said expenses be approved and ordered paid.

Adjourned.

WILLARD KENT, *Secretary.*

CHANGES OF ADDRESS.

Barnes, T. Howard
Civil and Municipal Engineer, 321 St. Charles Street, New Orleans, La.

Belcher, Donald M.
14 Prospect Street, Winchester, Mass.

Bolton, Charles M.
Care of C. M. Bolton & Co., Millwood, N. Y.

Breitzke, Charles F.
New York Board of Water Supply, New Paltz, N. Y.

Brown, Robert H.
Assistant Engineer, 21 West 127th Street, New York City.

Breuchaud, Jules
Contractor and Civil Engineer, The Belnord, Broadway and 86th Street, New York City.

Child, J. H.
129 Ballon Street, Woonsocket, R. I.

Coffin, Theodore D. L.
Katonah, N. Y.

Cole, D. W.
Project Engineer, United States Reclamation Service, Fallon, Nev.

Ferguson, John N.
Assistant Engineer, Massachusetts Harbor and Land Commission, 131 State House, Boston, Mass.

Gregory, John H.
Hydraulic and Sanitary Engineer, 53 Christopher Street, Montclair, N. J.

Hapgood, Lyman P.
1394 Main Street, Athol, Mass.

Hubbell, Clarence W.
Chief Engineer, Bureau of Public Works, Manila, P. I.

King, Arthur C.
Civil Engineer, 650 Chestnut Street, Springfield, Mass.

McKenzie, William A.
Wallingford, Conn.

Merrill, Andrew S.
Mountain Spring Cottage, East Brownfield, Me.

Miller, Stanley A.
Hydraulic Engineer, care of Director Oral de Obras Publicas, Santo Domingo, R. D.

Pratt, R. Winthrop
Chief Engineer, Ohio State Board of Health, Columbus, Ohio.

Reagan, John F., Jr.
183 Park Ave., Utica, N. Y.

Reynolds, John P., Jr.
28 Myrtle Ave., Plainfield, N. J.

Wasteneys, Hardolph
Rockefeller Institute for Medical Research, 66th Street and Avenue A, New York City.

Wegmann, Edward
Consulting Engineer, Aqueduct Commission, 13-21 Park Row, Room 332, New York City.

Wittemore, W. P.
Peacedale, R. I.

Whitten, Ernest P.
Cebu, P. I.

NEW MEMBERS.

Burgan, John A.
Water Commissioner, Hammonton, N. J.

Bryant, Henry F.
Engineer, 334 Washington Street, Brookline, Mass.

Dunlap, Fred C.
Chief Engineer, Bureau of Water, 790 City Hall, Philadelphia, Pa.

Holtzmann, George
Supt., Water Works, P. O. Box 714, Schenectady, N. Y.

Looney, Edward J.
Supt., Belmont Water Works, 275 Waverly Street, Belmont, Mass.

Rea, Richard W.
Civil Engineer, 1011 Alaska Bldg., Seattle, Wash.

Ratz, Charles E.
Supt., Water Works, Punxsutawney, Pa.

Ramsey, W. H. C.
Supt., Johnstown Water Co., Johnstown, Pa.

Sampson, Frank A.
Supt., Water Works, Kingston, Mass.

Seymour, William W.
President, Ellensbury Water Supply Co., Provident Bldg., Tacoma, Wash.

Sickman, A. F.
Hydraulic Engineer, Holyoke Water Power Co., Holyoke, Mass.

Wagner, Bernard M.
Engineer in Charge Construction, Water Dept., 396 Village Avenue, Rockville Centre, L. I.

DEATHS.

Jackson, William
Elected a member June 11, 1890. Died June 30, 1910.

Rollins, Charles H.
Elected a member February 13, 1907. Died July 20, 1910.

Simin, N. P.
Elected a member March 14, 1906. Died July 17, 1909.

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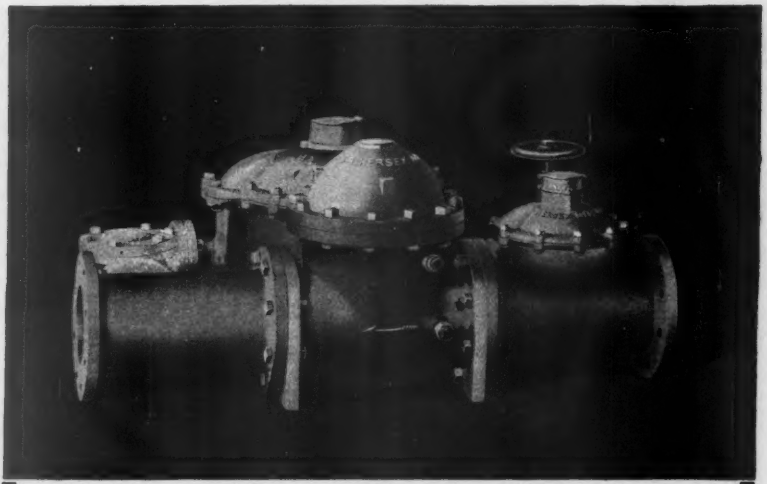

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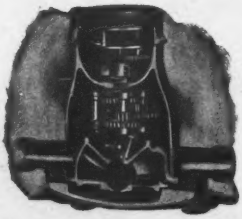

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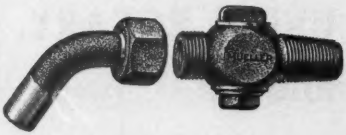

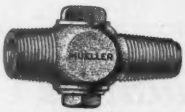

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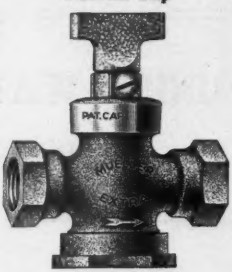

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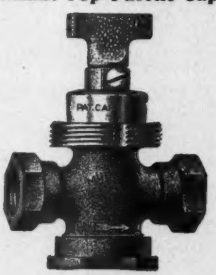

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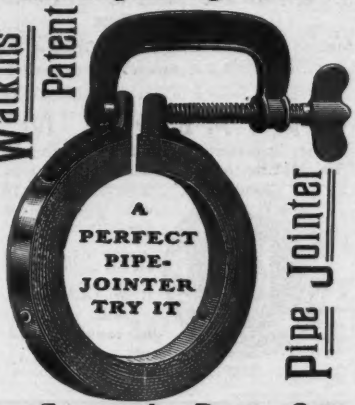

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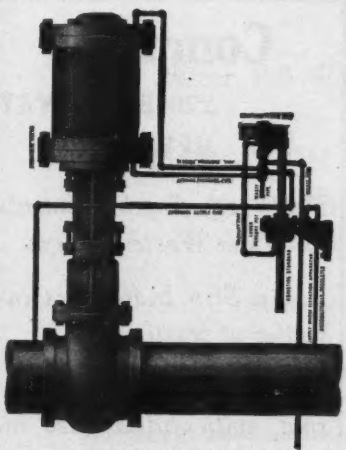

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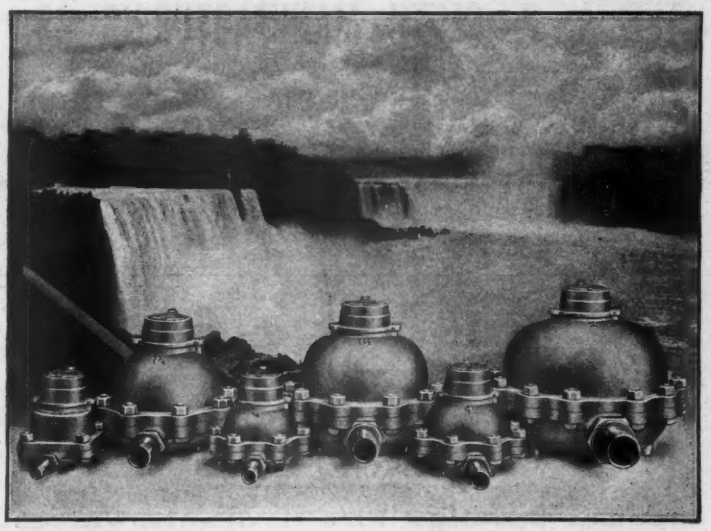

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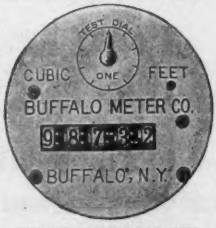

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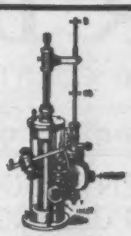

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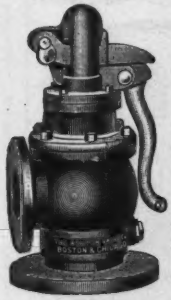

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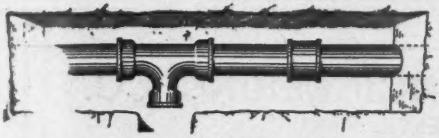

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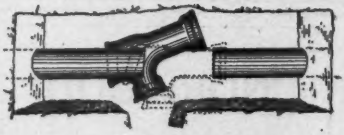

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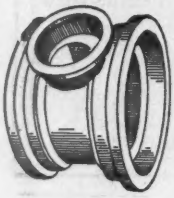

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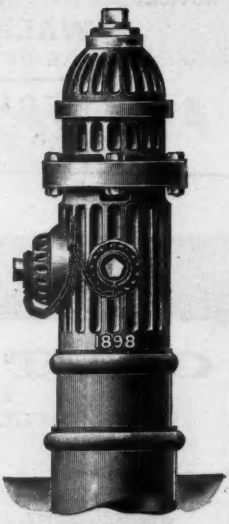

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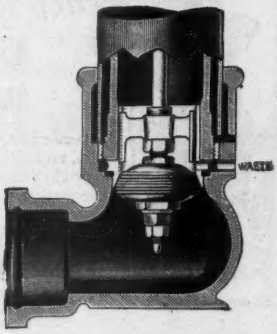

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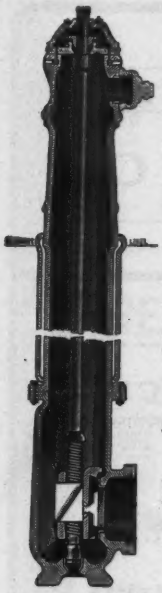

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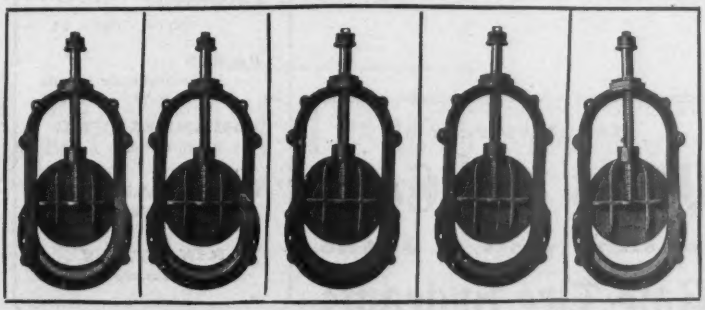

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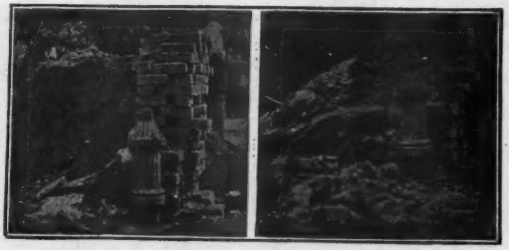

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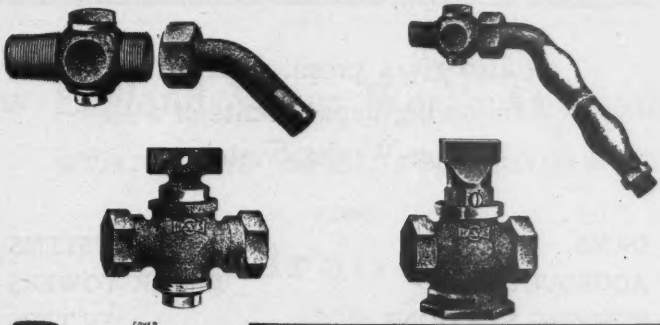

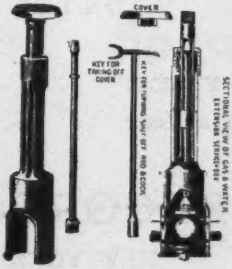
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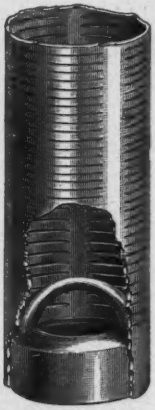

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